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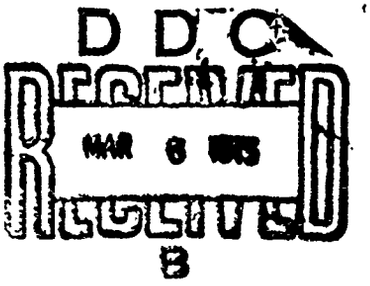
AFFDL-TR-72-147 – VOL. II

PROPULSION SYSTEM INSTALLATION CORRECTIONS

VOLUME II:

PROGRAMMERS MANUAL

W. H. BALL
THE BOEING COMPANY



TECHNICAL REPORT AFFDL-TR-72-147 – VOL. II
DECEMBER 1972

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PROPULSION SYSTEM INSTALLATION CORRECTIONS

VOLUME II:

PROGRAMMERS MANUAL

W. H. BALL

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FOREWORD

This report was prepared by the Research and Engineering Division, Aerospace Group, of The Boeing Company under Air Force Contract F33615-72-C-1580, "Propulsion System Installation Corrections", Project 1366. The program was conducted under the direction of the Prototype Division, Air Force Flight Dynamics Laboratory, Air Force Systems Command. Mr. Gordon Tamplin was the Air Force Program Monitor.

The program was initiated on 31 December 1971 and draft copies of the final reports were submitted for approval on 31 October 1972.

Dr. P. A. Ross was Program Manager and Mr. W. H. Ball was principal investigator during the program. Significant contributions to the program were made by the following individuals: Mr. Joe Zeeben, engine performance; Dr. Franklin Marshall, inlet and exhaust system technology; Mr. John Petit, nozzle internal performance and nozzle/afterbody drag; and Mr. Gary Shurtleff, programming.

This report contains no classified information extracted from other classified reports.

Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

Ernest J. Cross Jr.

Lt. Col. Ernest J. Cross, Jr.
Chief, Prototype Division
Air Force Flight Dynamics Laboratory

ABSTRACT

This report presents the results of a research program to develop a procedure for calculating propulsion system installation losses. These losses include inlet and nozzle internal losses and external drag losses for a wide variety of subsonic and supersonic aircraft configurations up to Mach 4.5. The calculation procedure, which was largely developed from existing engineering procedures and experimental data, is suitable for preliminary studies of advanced aircraft configurations. Engineering descriptions, equations, and flow charts are provided to help in adapting the calculation procedures to digital computer routines. Many of the calculation procedures have already been programmed on the CDC 6600 computer. Program listings and flow charts are provided for the calculation procedures that have been programmed. The work accomplished during the program is contained in four separate volumes. Volume I contains an engineering description of the calculation procedures. Volume II is a programmer's manual containing flow charts, listings, and subroutine descriptions. Volume III contains sample calculations and sample input data. Volume IV contains bookkeeping definitions and data correlations.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

SYMBOLS AND NOMENCLATURE

A	Area, in^2
A_C	Inlet capture area, in^2
A_O	Local stream tube area ahead of the inlet, in^2
A_{O_I}	Free-stream tube area of air entering the inlet, in^2
AR	Aspect ratio, dimensionless
B	Velocity decay exponent, dimensionless
C	Sonic velocity, ft/sec.
C_D	Drag coefficient, $\frac{D}{qA_{REF}}$, dimensionless
C-D	Convergent-divergent
$C_{D_{ADD}}$	Additive drag coefficient, $C_{D_{ADD}} = \frac{D_{ADD}}{qA_C}$, dimensionless
$C_{D_{A_{MAX}}}$	Afterbody drag coefficient, $\frac{DRAG}{qA_{MAX}}$, dimensionless
$C_{D_{Base}}$	Base drag coefficient $\frac{(P_b-P_\infty)A_{BASE}}{qA_{MAX}}$, dimensionless
C_{D_S}	Scrubbing drag coefficient, $\frac{DRAG}{qA_{MAX}}$, dimensionless
C_{f_g}	Thrust coefficient, $\frac{F_g}{\frac{w}{g}(V_{cp})}$, dimensionless
C_S	Stream thrust coefficient, dimensionless, (defined by Figure 48 of Volume IV)
C_V	Nozzle velocity coefficient, dimensionless
Conv.	Convergent
D	Drag, lb.; Hydraulic Diameter, $\frac{4A}{P}$, in., diameter, in.

SYMBOLS AND NOMENCLATURE (Continued)

F	Thrust, lb.
F_{g_i}	Ideal gross thrust (fully expanded), lb.
f/a	Fuel/air ratio, dimensionless
g	Gravitational constant, ft/sec^2
h	Enthalpy per unit mass, BTU/lb.; height, in.
h_{fan}	Enthalpy of fan discharge flow, BTU/lb
h_{pri}	Enthalpy of primary exhaust flow after heat addition BTU/lb
h_t	Throat height, in^2
K	Velocity decay coefficient, dimensionless
L	Length, in.
M	Mach number, dimensionless
P	Pressure, lb/in^2
P_r	Relative pressure; the ratio of the pressures p_a and p_b corresponding to the temperatures T_a and T_b, respectively, along a given isentrope, dimensionless
P_T	Total pressure, lb/in^2
Q	Effective heating value of fuel, BTU/lb.
q	Dynamic pressure, lb/in^2
R, r	Radius, in.
S	Nozzle centerline spacing, in.
T	Temperature, °R
V	Velocity, ft/sec

W	Mass flow, lb/sec
W_{BX}	Bleed air removed from engine, lb/sec.
W_C, $\frac{W\sqrt{\theta}}{\delta}$	Corrected airflow, lb/sec.
W_f	Weight flow rate of fuel, lb/sec.
W_2	Weight flow rate of air, primary plus secondary, lb/sec.
W_8	Primary nozzle airflow rate, lb/sec.
x	Length, in.
α	Angle of attack; convergence angle of nozzle, degrees
γ	Ratio of specific heats, dimensionless
ϵ	Diffuser loss coefficient, $\frac{\Delta P_T}{q}$, dimensionless
η_B	Burner efficiency, dimensionless
ν	Kinematic viscosity, ft^2/sec.
ρ	Density, lb/ft^3

SUBSCRIPTS

B	Burner
b, base	Base flow region
BP	Bypass
BLC	Boundary layer bleed
btail	Boattail
c	Core (nozzle); capture (inlet)
DES	Design conditions

SUBCRIPTS

e	Boattail trailing edge
EFF	Based on effective area
ENG	Refers to engine demand
f	Fuel
g	gross
GEOM	Based on geometric area
int	Interference; internal
ip	Ideal, primary exhaust flow
jet	Exhaust flow jet
max	Maximum
min	Minimum
s	Scrubbing flow region
SPILL	Spillage
T	Total condition; throat station
t_f	Total condition, fan flow
T/O	Takeoff
t_p	Total condition, primary flow
o	Local conditions ahead of inlet
2	Compressor face station
8	Nozzle throat station
9	Nozzle exit station
18	Fan discharge throat station
∞	Free-stream condition
x	Local

SECTION I

GENERAL DESCRIPTION OF COMPUTER PROGRAM

The engine installation calculation procedure naturally breaks into three divisions: inlet, engine, and nozzle/afterbody. Each of these divisions is represented in TEM-333 by a set of subprograms logically subordinate to a monitoring subprogram which functions as a quasi-main program for that set. The term module will be used to designate a quasi-main and its subordinate programs. Further, within a module procedures are subprogrammed to isolate the procedures from one another and to isolate logical direction programming from computational programming. The benefits of this organization are threefold. First, checkout. Each module can be checked out independently of the others. Secondly, logical simplicity. The logical structure of the program as a whole is more apparent. Individual subprograms are simpler; being small with a limited purpose. Finally, ease of modification. Engine installation programs are constantly undergoing modification so the ability to attach and detach new modules or procedures quickly is a necessity. The small subprogram-module arrangement allows for quick change since the connection to the next level is more apparent.

The modules are tied together by subroutine CØMPUTE which calculates the installed performance for a single uninstalled performance point. The main program, TEM-333, handles calls to the input routines, then reads the uninstalled performance points one-by-one; calling CØMPUTE for each, outputting data when required until the last point has been computed.

Programs included in TEM-333 and their purposes are:

TEM-333 - Main Program, monitors program logic

COMPUTE - Controls calculation of a performance point

<u>Inlet Module</u>

TABIN - Reads Inlet Input Deck

INLDRAG - Monitors Inlet Drag Computation

AIRBYP - Computes External-Compression Mode

AIRSPL - **Computes Mixed Compression Mode**

SIZINL - **Computes Inlet Capture Area**

DEMAND - **Computes Engine Demand**

AREAF - **Computes** F_1 **where** $A_O = F_1 W_C^{\eta}$

Afterbody Module

ABINPT - **Reads Nozzle Input Deck**

DRAGAB - **Monitors Afterbody Drag Calculations**

DINTFR - Computes Nozzle Interference Drag

DBØATR - Monitors Boattail Drag Computation

DBASER - Computes Base Drag

DBTTB - Computes $C_{D_{BT}} = f(M, PS)$

CDCØNV - Monitors C-D Nozzle Boattail Computation

PLUGMX - Computes Boattail Drag for Plug Nozzle, Mixed Flow

PLUGNM - Computes Boattail Drag for Plug Nozzle, Non-mixed Flow

DRG - Computes Boattail Drag for C-D Nozzle

SUBBT - Computes Subsonic $C_{D_{BT}}$ for C-D Nozzle

SUPBT - Computes Supersonic $C_{D_{BT}}$ for C-D Nozzle

CABTAB - Computes $C_{D_{BT}}$ as Function of A_{10}/A_9

AEXHST - Computes Nozzle Exit Area

Engine Module

PERF - Computes Gross Thrust

CHKRP - Computes Thermodynamic Properties at Throat

GTHRST - Computes Performance of Propulsive Nozzles

HØFT - Computes Enthalpy Given Temperature

TØFH - Computes Temperature Given Enthalpy

PRØFH - Computes Relative Pressure Given Enthalpy

HØFPR - Computes Enthalpy Given Relative Pressure

CØFH - Computes Critical Velocity Given Total Enthalpy

CØFHT - Computes Critical Velocity Given Static Enthalpy

Miscellaneous Programs

STØRE - Stores results of a performance point

ØUTGØ - Outputs an engine performance matrix

WARNING - Prints warning message heading

FIXDIM - Determine dimensions of A8 and A9 input

ATMØS - Computes atmospheric data

DATA - Transfers and output input card images

Tabular Input Programs

TABL1 - Inputs table format 1 tables

TABL2 - Inputs table format 2Q tables

TABL22 - Inputs table format 2K tables

TABL3 - Inputs table format 3 tables

PLACIN - Reads a tabular array

KØUNT - Counts non-blank input fields

Linear Interpolation Programs

TABU1 - Interpolates F = f(x)

TABU2 - Interpolates F = f(x,y)

TABU3 - **Interpolates F = f(x,y,z)**

IFIND - **Finds Interpolation Interval**

FACINT - **Computes Interpolation Factor**

CVINT - **Perform Linear Interpolation Calculation**

SECTION II

DESCRIPTIONS OF SUBROUTINES AND LISTINGS

SUBJECT: PRØGRAM TEM-333

PURPØSE: Main Program TEM-333 monitors the overall program logic.

METHØD: All supporting data is input, then the program reads performance points one by one, computes and stores the results, and outputs an array of results whenever Mach or altitude changes.

USAGE: PRØGRAM TEM333 (INPUT, ØUTPUT, TAPE5, TAPE6 = ØUTPUT, TAPE1 = INPUT)

INPUT or TAPE1	System Input
ØUTPUT or TAPE6	System output
TAPE5	Card Images of Input
TAPE7	MARK II output

SUBPRØGRAMS:

ABINPT	DATA	FIXDIM
ØUTGØ	STØRE	TABIN
TABL1	TABL2	

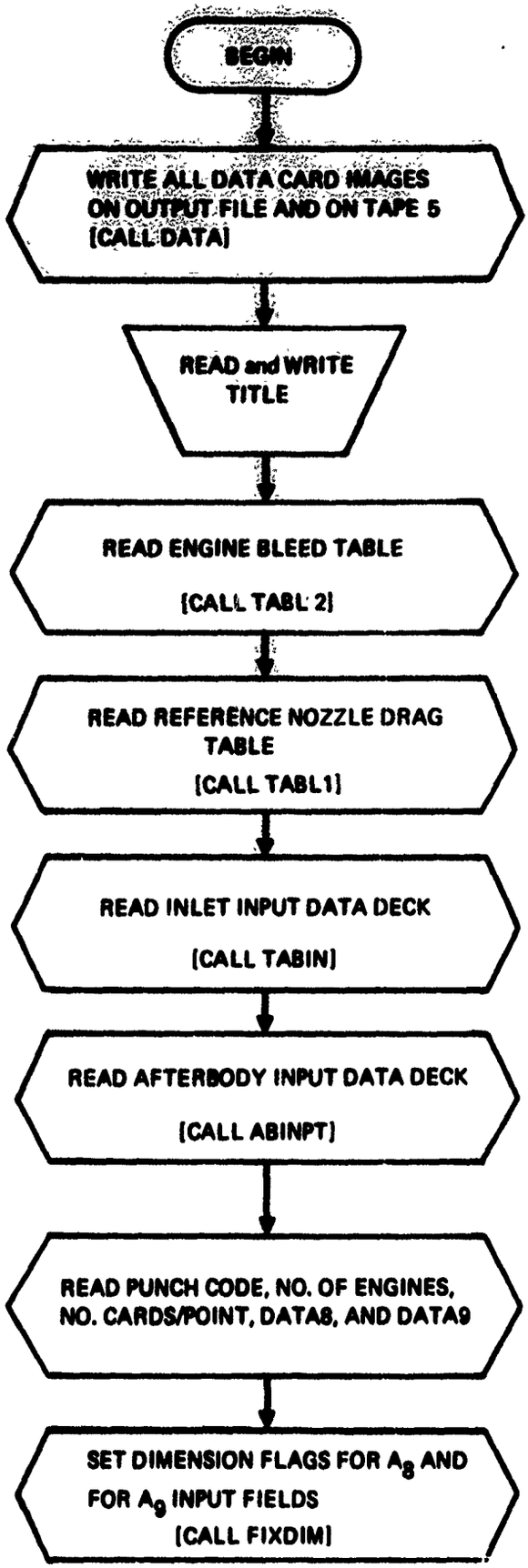


Figure 1: FLOW CHART FOR PROGRAM TEM 333

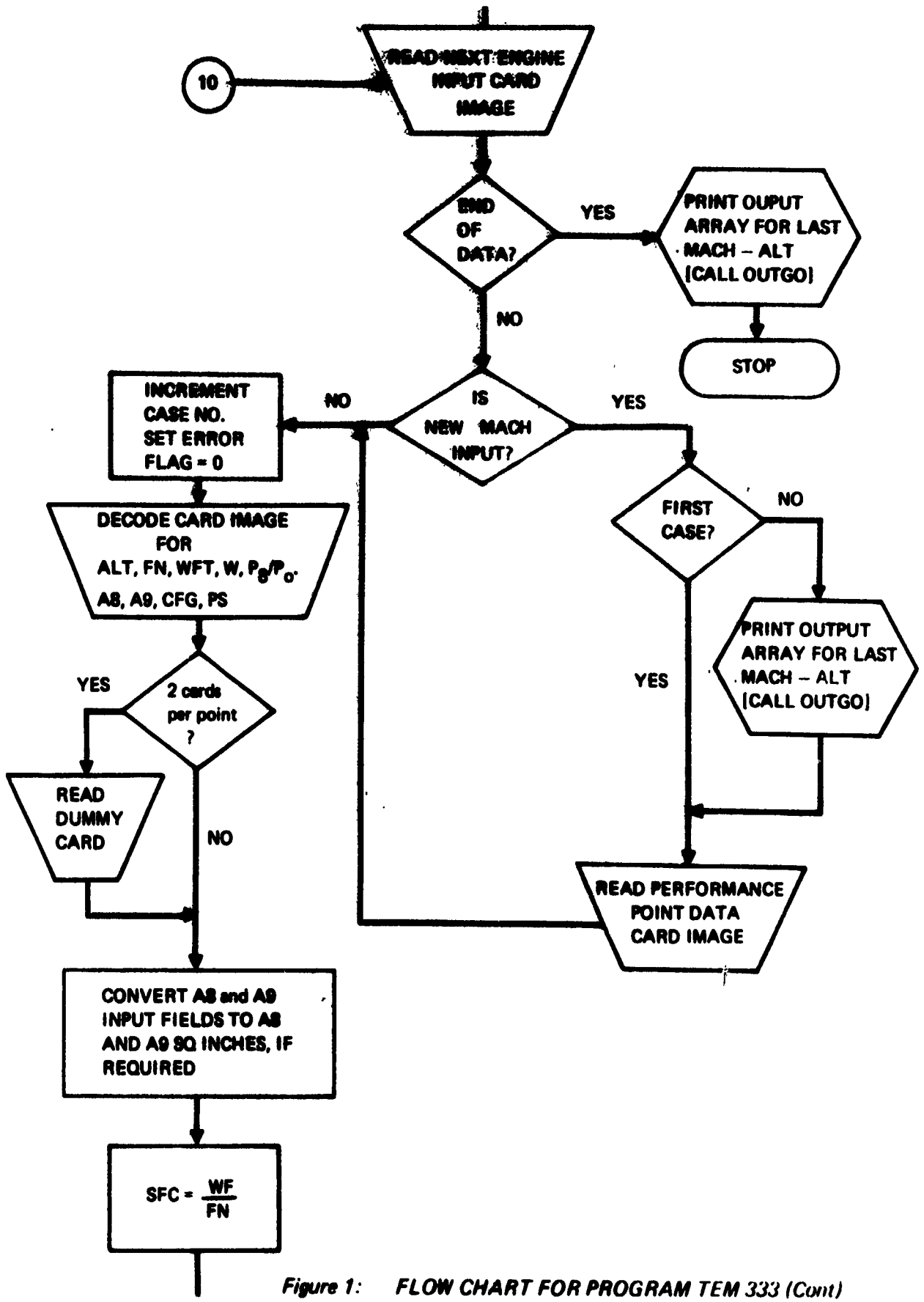


Figure 1: FLOW CHART FOR PROGRAM TEM 333 (Cont)

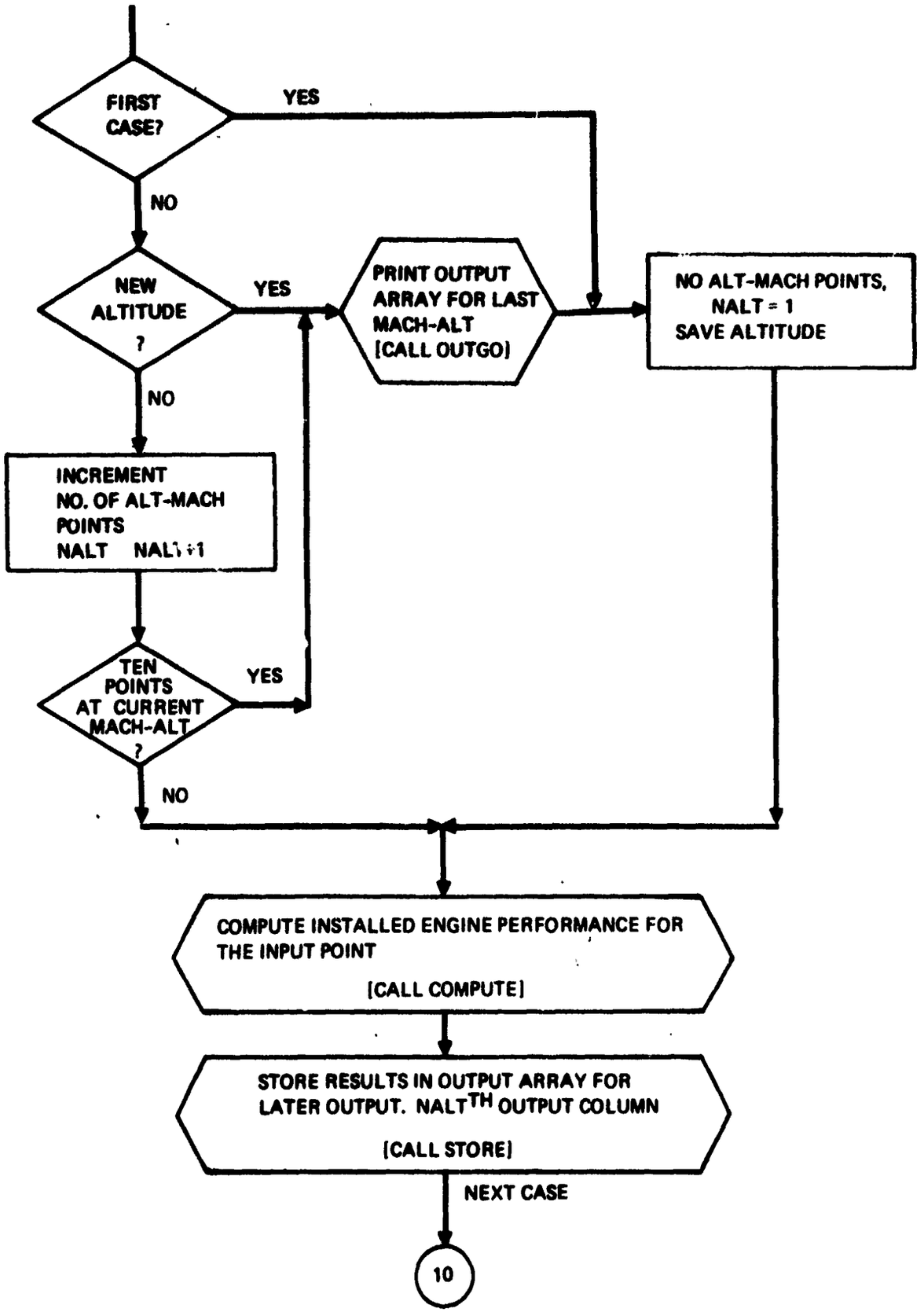


Figure 1: FLOW CHART FOR PROGRAM TEM 333 (Concluded)

```
S*BJAML.  0000000000000000000000000000J000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
S*BJAML.  0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

RUN  VERSION JUL 71          22.46.30. 72/J8/23.                                                                    PAGE 001

                PROGRAM TEM333(INPUT,OUTPUT,TAPE5,TAPE6=OUTPUT,TAPE1=INPUT,                          INDRAG20
               X TAPE7)                                                                               INDRAG30
          C
 000033       COMMON/ENGNO/ENGNO,XONI,XOBASE
          C    INITIALIZATION OF PHYSICAL CONSTANTS                                                   INDRA130
          C       G , GRAVITY ACCELERATION = 32.174 FT/SEC**2                                         INDRA140
          C       GAMMA , SPECIFIC HEAT RATIO CP/CV = 1.40 FOR AIR                                    INDRA150
          C       R , GAS CONSTANT = 53.34 FT LB/LB DEG F(ABS)                                        INDRA160
          C    PROGRAMMING INITIALIZATION                                                             INDRA180
 000033       COMMON /MACHW8/MACHW8(120),NKW8,NYW8
 000033       COMMON/JNREF/JNREFM(20),NONREF
 000033       COMMON/INS/ MACH,OLDALT,CON
 000033       COMMON/GAMMA/GAMMA
 000033       COMMON/G/G
 000033       COMMON/R/R
 000033       COMMON/TAPENO/IN,IOUT                                                                  INDRA190
 000033       COMMON/IBAD/IBAD                                                                       INDRA200
 000033       COMMON/IDATA/IDATA                                                                     INDRA210
 000033       COMMON /OUTS/ CASE, ALT, PS, ENA, WFTRF, SFCOUT, FNRF, FRAM, RF,
             1              MILRF, DINLET, COSPL, COBLD, COBYP, COINL, ONOZ,
             2              COUT, CUBASE, CDINT, DNOZRF, P8P0, A9, A8, CFG,
             3              BETA, FN, WFT, SFC, W, WABS, FNCOR, WFCOR, SFCCOR,
6            4FAMB, P8MB, TTO, Q, AOEAC,AOIAC,AJAC,STATUS,EXTRA(4)
 000033       COMMON/TITLE/TITLE(8)
 000033       COMMON/PCODE/PCODE
 000033       COMMON/DATE/DA,TE
 000033       COMMON/CARD/CARD(5)                                                                    INDRA270
 000033       COMMON/KTRAN/KTRAN                                                                     INDRA280
 000033       COMMON/NEWM/NEWM                                                                       INDRA290
 000033       REAL MILRF
 000033       REAL MACH
 000033       DATA G/32.174/, GAMMA/1.40/, R/53.34/                                                  INDRA320
 000033       DATA BLANK/1H          /                                                               INDRA330
 000033       DATA IN,IOUT/5,6/                                                                      INDRA340
 000033       DATA OLDALT/-957654./                                                                  INDRA350
 000033       DATA CASE/3.0/                                                                         INDRA360
 000033       DATA NMACH/1/                                                                          INDRA370
 000033       DATA PI8/4/.7854/
 000033       DATA MASK20 /1CMOVE CARD    /
 000033       DATA NALT/1/                                                                           INDRA380
          C                                                                                          INDRA410
          C    BEGIN EXECUTION OF PROGRAM                                                            INDRA420
 000033       CALL DATA                                                                              INDRA440
          C                                                                                          INDRA450
          C    CALL DATE(DA,TE)
 000034       READ(5,333) TITLE
 000112       WRITE(6,334) TITLE
 000120       WRITE(6,337)
 000124   607 FORMAT(*1W8 TABLE*)
 000124       CALL TABL2(MACHW8(1),10,10,NKW8,NYW8)
 000130       WRITE(6,338)
 000134       CALL TABL1(JNREFM,10,NONREF)
```

```
S*8JAML.  0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
S*8JAML.  0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

RUN  VERSION JUL 71          22.46.30. 72/38/23.                                                    PAGE 001

                PROGRAM TEM333(INPUT,OUTPUT,TAPE5,TAPE6=OUTPUT,TAPE1=INPUT,                    INDRAG20
               X TAPE7)                                                                        INDRAG30
          C
 000033       COMMON/ENGNO/ENGNO,XONI,XOBASE
          C    INITIALIZATION OF PHYSICAL CONSTANTS                                           INDRA130
          C       G , GRAVITY ACCELERATION = 32.174 FT/SEC**2                                 INDRA140
          C       GAMMA , SPECIFIC HEAT RATIO CP/CV = 1.40 FOR AIR                            INDRA150
          C       R , GAS CONSTANT = 53.34 FT LB/LB DEG F(ABS)                                INDRA160
          C    PROGRAMMING INITIALIZATION                                                     INDRA180
 000033       COMMON /MACHW8/MACHW8(120),NMW8,NYW8
 000033       COMMON/TNREF/UNREFM(20),NUNREF
 000033       COMMON/LNS/ MACH,OLDALT,CON
 000033       COMMON/GAMMA/GAMMA
 000033       COMMON/G/G
 000033       COMMON/R/R
 000033       COMMON/TAPENO/IN,IOUT                                                          INDRA190
 000033       COMMON/IBAD/IBAD                                                               INDRA200
 000033       COMMON/IDATA/IDATA                                                             INDRA210
 000033       COMMON /OUTS/ CASE, ALT, PS, PNA, WFTRF, SFCOUT, FNRF, FRAM, RF,
             1              MILRF, DINLET, CDSPL, CDBLD, COBYP, CDINL, DNOZ,
             2              CDUT, CUBASE, CDINT, DNOZRF, P8P0, A9, A8, CFG,
             3              BETA, FN, WFT, SFC, M, MABS, FNCOR, WFCOR, SFCCOR,
            4FAM8, PAM8, TTO, Q, AOEAC,AOIAC,AJAC,STATUS,EXTRA(4)
 000033       COMMON/TITLE/TITLE(8)
 000033       COMMON/PCODE/PCODE
 000033       COMMON/DATE/DA,TE
 000033       COMMON/CARD/CARD(8)                                                            INDRA270
 000033       COMMON/KTRAN/KTRAN                                                             INDRA280
 000033       COMMON/NEWM/NEWM                                                               INDRA290
 000033       REAL MILRF
 000033       REAL MACH
 000033       DATA G/32.174/, GAMMA/1.40/, R/53.34/                                          INDRA310
 000033       DATA BLANK/1H     /                                                            INDRA320
 000033       DATA IN,IOUT/5,6/                                                              INDRA330
 000033       DATA OLDALT/-987654./                                                          INDRA340
 000033       DATA CASE/0.0/                                                                 INDRA350
 000033       DATA NMACH/1/                                                                  INDRA360
 000033       DATA PI/4*.7854/
 000033       DATA MASK2C /1CMOVE CARD   /
 000033       DATA NALT/1/                                                                   INDRA390
          C                                                                                   INDRA400
          C    BEGIN EXECUTION OF PROGRAM                                                     INDRA420
 000033       CALL DATA                                                                      INDRA450
          C                                                                                   INDRA460
          C    CALL DATE(DA,TE)
 000034       READ(5,603) TITLE
 000112       WRITE(6,604) TITLE
 000120       WRITE(6,607)
 000124   607 FORMAT(*1H8 TABLE*)
 000124       CALL TABL2(MACHW8(1),10,10,NMW8,NYW8)
 000130       WRITE(6,608)
 000134       CALL TABL1(UNREFM,10,NUNREF)
```

```
000334          CALL STORE(NALT)
000306          GO TO 10                                              INDR1080
000337     7777 CALL OUTSO(NALT)
000311          CALL EXIT                                             INDR1100
000312      600 FORMAT(6A10)                                          INDR1110
000312      601 FORMAT(F7.0,3X)                                       INDR1120
000312      602 FORMAT(7X,9F7.0)                                      INDR1130
000312      603 FORMAT(10F7.0)                                        INDR1140
000312      604 FORMAT(1H1,45X,*IEM-333 ENGINE PERFORMANCE PROGRAM*/1H0,23X,6A10)
000312      606 FORMAT(*0PCODE* F4.1,5X,*NO. ENGINES*,F4.1,5X,A10,* INPUT/POINT*
               A 2F2.1)
000312          END                                                   INDR1150
```

PROGRAM LENGTH INCLUDING I/O BUFFERS
013527

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

10	-	000129	15	-	000136	20	-	000153	40	-	000176
50	-	000255	55	-	000257	60	-	000266	70	-	000272
80	-	000277	90	-	000303	600	-	000345	601	-	000347
602	-	000352	603	-	000355	604	-	000357	606	-	000367
607	-	000330	608	-	000334	7777	-	000307			

EXTERNALS AND TAGS

DATA	-	S00200	INPUTC.	-	S00360	OUTPTC.	-	S00400	TABL2	-	S00500
TABL1	-	S00600	TABIN	-	S00700	ABINPT	-	S01000	FIXDIM	-	S01100
IFENOF.	-	S01200	INPUTS.	-	S01300	OUTSO	-	S01400	COMPUTE	-	S01500
STORE	-	S01600	EXIT	-	S01700	END.	-	S02000	QENTRY.	-	S00100

BLOCK NAMES AND LENGTHS

ENGNO	-	000003	MACHW8	-	000172	UNREF	-	000025	INS	-	000003
GAMMA	-	000001	6	-	000001	R	-	000031	TAPENO	-	000002
IBAD	-	000001	IDATA	-	000001	OUTS	-	000055	TITLE	-	000010
PCODE	-	000001	DATE	-	000002	CARD	-	000010	KTRAN	-	000001
NEWN	-	000001									

VARIABLE ASSIGNMENTS

ALT	-	000001C13	A8	-	000026C13	A9	-	000025C13	BLANK	-	000376
CARD	-	000003C17	CASE	-	000000C13	CF6	-	000027C13	CON	-	000002C04
DATA3	-	000004	DATA9	-	000005	UNREFM	-	000000C03	ENGNO	-	000001C01
EXTRA	-	000001C13	FN	-	000031C13	J	-	000000C06	GAMMA	-	000000C05
IDATA	-	000000C12	IN	-	000000C10	IOUT	-	000001C13	J8	-	000400
J9	-	000011	KASE	-	000415	K8	-	000407	K9	-	000412
L8	-	000010	L9	-	000013	MAC4	-	000000C04	MACHW8	-	000000C02
MAS<2C	-	000001	MILRF	-	000011C13	NALT	-	000402	NONREF	-	000002C03
NEWN	-	000000021	NMACH	-	000377	NXW3	-	000170C12	NYW8	-	000171C02
OLDALT	-	000001C04	PCODE	-	000000C15	PIBY4	-	000400	PS	-	000002C13
PSPI	-	000004C13	R	-	000000C07	SFC	-	000033C13	STATUS	-	000050C13
TITLE	-	000000014	TNORD	-	000403	W	-	000034C13	WFT	-	000032C13
X	-	000014	XBASE	-	000002C01	XONI	-	000001C11	ZEEBEN	-	000416

START OF CONSTANTS
000513

START OF TEMPORARIES
000376

START OF INDIRECTS
000376

SPACE REQUIRED TO COMPILE
037306

SUBJECT: **SUBRØUTINE CØMPUTE**

PURPØSE: **SUBRØUTINE CØMPUTE controls the calculation of the installed performance for a single input case.**

METHØD: **Using the input performance data CØMPUTE first calculates atmospheric data and the reference recovery factor (MIL STD 5008 B). Gross thrust is computed for the input W_F, W_O, and P_8/P_O.**

The inlet module is called to find inlet drag and recovery factor. Then a second gross thrust calculation is made using values corrected by the recovery ratio. The input array to the afterbody module is loaded and the module called to compute afterbody drags. Reference afterbody drag is obtained by interpolation. Now installed thrust is calculated by combining the appropriate terms and the total calculation is complete.

USAGE: CALL CØMPUTE

All inputs are in labeled CØMMØN blocks.

Input variables are:

Mach, ALT, PS, P_8/P_O, A_9, A_8, F_N, W_{F_T},

SFC, W_{O_C}, Table 2.1, W_{BLD} = f(Mach, ALT),

and Table 2.2, $C_{D_{AB_{REF}}}$ = f(Mach).

All of these input variables are direct input to the program or immediate consequences of the input, e.g.

SFC = W_F/F_N.

SUBPRØGRAMS:

ATMØS	**DRAGAB**	**INLDRAG**
PERF	**SQRT**	**TABU1**
TABU2		

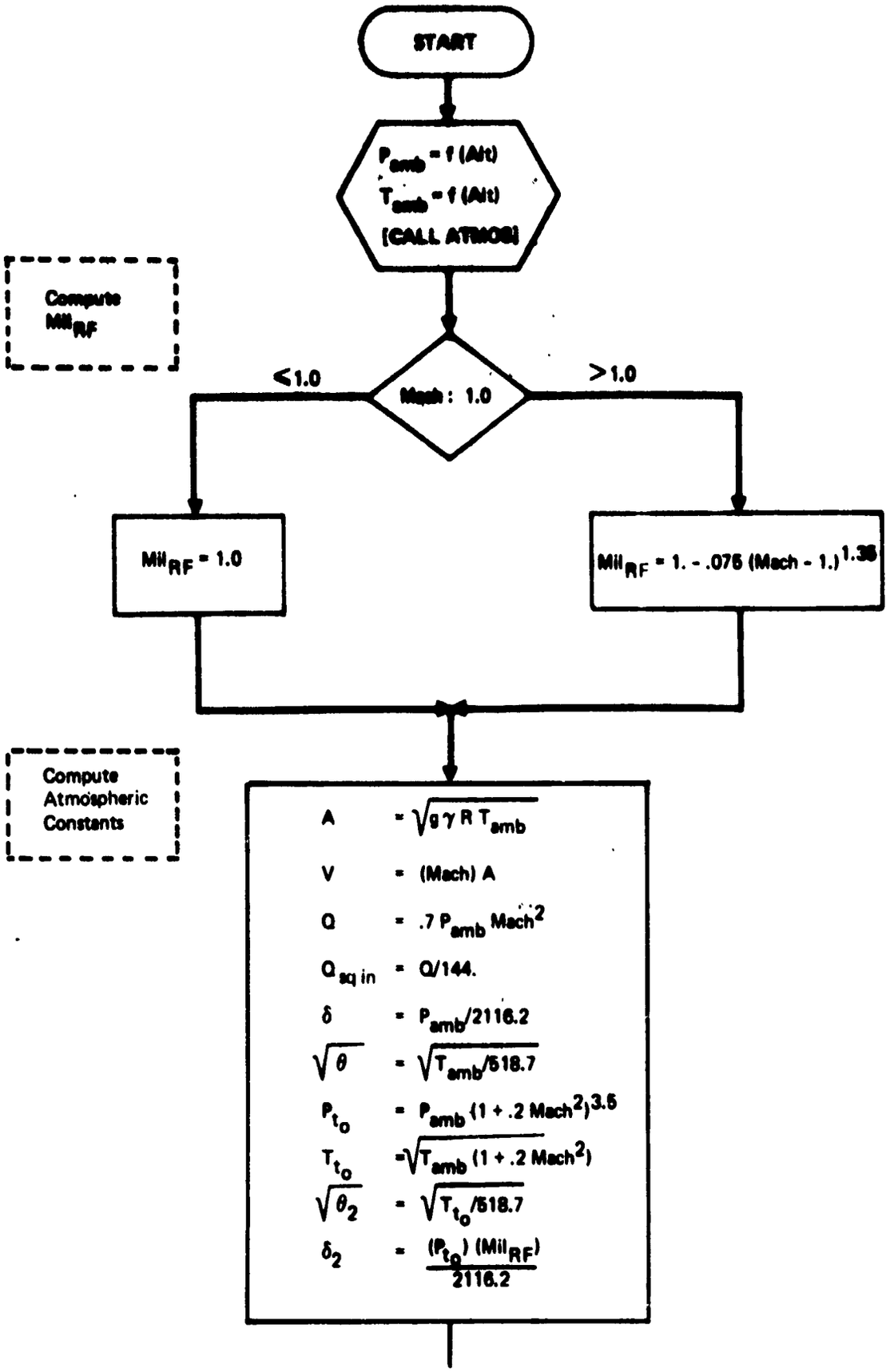


Figure 2: FLOW CHART FOR SUBROUTINE COMPUTE

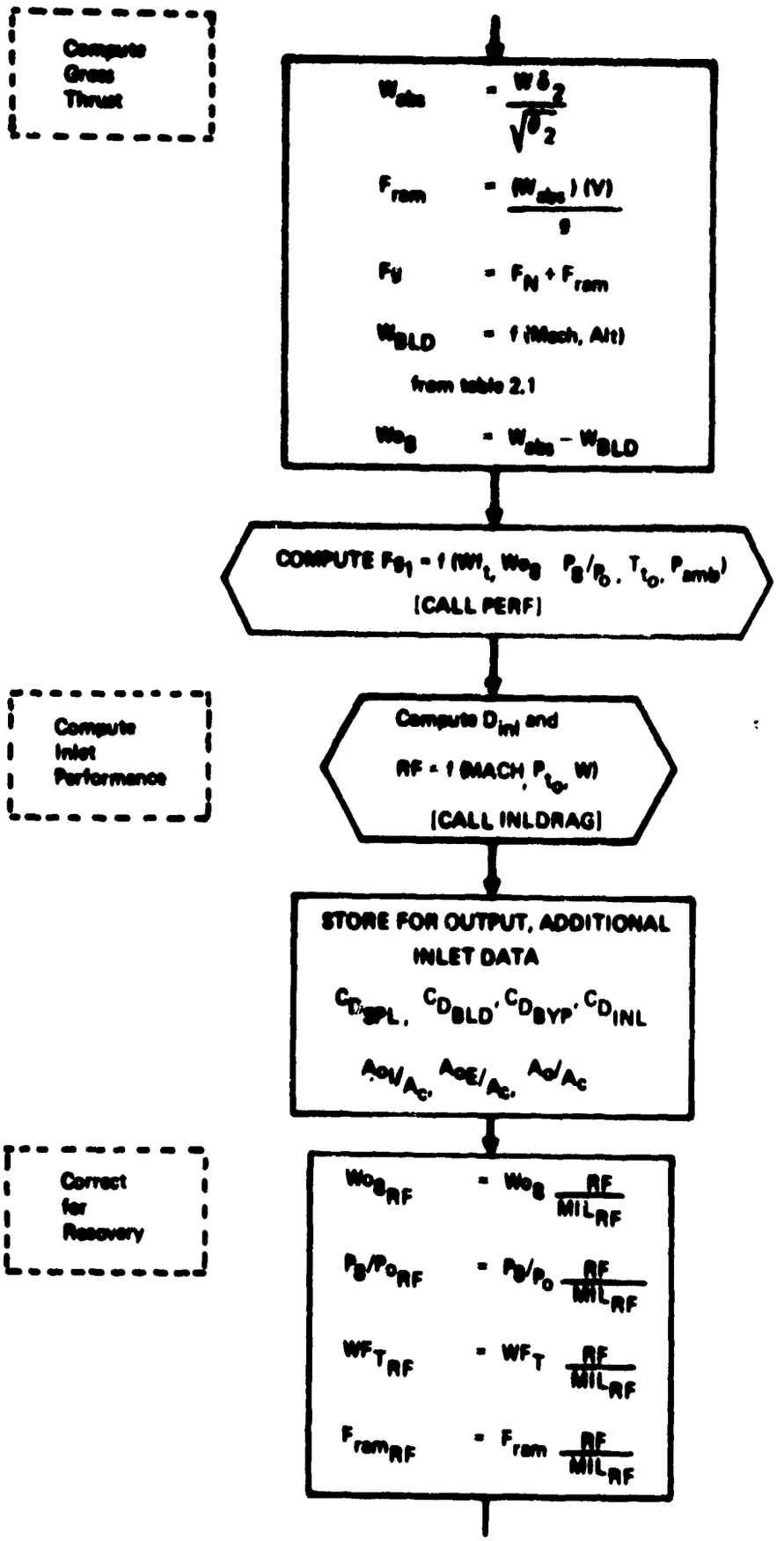


Figure 2: FLOW CHART FOR SUBROUTINE COMPUTE (Cont)

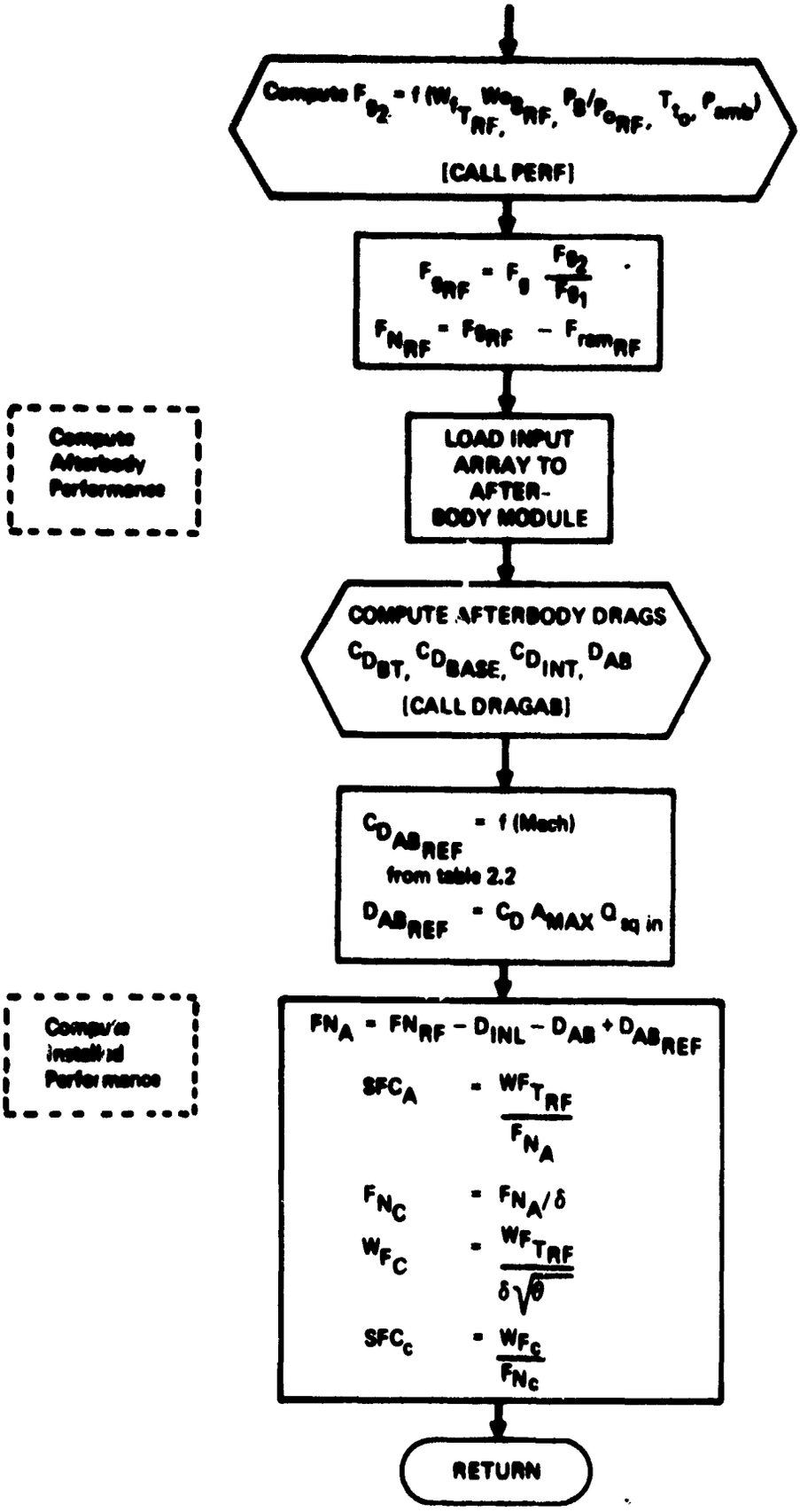


Figure 2: FLOW CHART FOR SUBROUTINE COMPUTE (Concluded)

```
      SUBROUTINE COMPUTE                                                COMPUT10
C                                                                       COMPUT20
      COMMON/INS/ MACH,OLDALT,CON
      COMMON/3/G
      COMMON /OUTS/ CASE, ALT, PS, FNA, WFTRF, SFCOUT, FNRF, FRAM, RF,
     1              MILRF, DINLET, CDSPL, CDBLD, CDBYP, CDINL, DNOZ,
     2              CDBT, CDBASE, CDINT, DNOZRF, P8P0, A9, A8, CFG,
     3              BETA, FN, WFT, SFC, W, WA8S, FNCOR, WFCOR, SFCCOR,
     4TAM8, PAM8, TT0, Q, AGEAC,AGIAC,AJAC,STATUS,EXTRA(4)
      COMMON/MACHW8/MACHW8(10),ALTW8(13),W8(10,10),NXW8,NYW8
      COMMON/DNREF/DNREFM(10),DNREFT(13),NDNREF
      COMMON /NOZARR/ A(40)
      COMMON/OUTINL/OUTINL(10)
      COMMON/ENGNO/ENGNO,XUNI,XOBASE
      DIMENSION O(10)
      REAL MILRF
      REAL MACH
      DATA PIBY4/.78540/
      DATA BY144/.00694444/
C                                                                       COMPU140
      CALL ATMOS(ALT,TAM8,PAM8)
      PSOIN=PAM8*BY144
   40 G=SQRT(G0*TAM8)                                                   COMPU320
      V=MACH*G                                                          COMPU330
      IF (MACH-1.0) 200,200,205                                         COMPU650
  200 MILRF=1.0                                                         COMPU660
      GO TO 210                                                         COMPU670
  205 MILRF=1.0-.075*(MACH-1.)**1.35                                    COMPU680
  210 Q=.7*PAM8*MACH**2
      PSOIN=Q*BY144
      DELTA=PAM8/2116.22                                                COMPU340
      RTHETA=SQRT(TAM8/518.69)                                          COMPU350
      ZZMACH=1.0+.2*MACH**2
      PT0=PAM8*ZZMACH**3.5
      TT0=TAM8*ZZMACH
      RTHET2=SQRT(TT0/518.69)
      DELTA2=PT0*MILRF/2116.22
C                                                                       COMPU360
      WA8S=W*DELTA2/RTHET2
      FRAM=WA8S*V/G
      FG=FN*FRAM
      W08=WA8S-TABU2(MACH,ALT,MACHW8,ALTW8,W8,    NXW8,NYW8,10,10)
      CALL PERF(WFT,W08,P8P0,TT0,PAM8,FG1,AE8)
      CALL INLDRAG(MACH,PT0,W,0.0,DINLET,RF)
      CDSPL=OUTINL(1)
      CDBLD=OUTINL(2)
      CDBYP=OUTINL(3)
      AGIAC=OUTINL(4)
      AGEAC=OUTINL(5)
      CDINL=OUTINL(6)
      AJAC=OUTINL(7)
      RATIO=RF/MILRF
```

```
000135          MOBRF=MOB*RATIO
000136          PBPORF=PBPO*RATIO
000140          AFTRF=AFT*RATIO
000141          CALL PERF(AFTRF,MOBRF,PBPORF,TTO,PAMB,FG2,AEB)
000150          FGRF=FG*FG2/FG1
000153          FNRF=FGRF-FRAM*RATIO
          C     SET UP AFTERBODY DRAG MODULE INPUT ARRAY
000156          A(1)=AEB
000157          A(2)=AB
          C     A(3)=0.0
          C     A(4)=0.0
000161          A(5)=PBPO
          C     A(6)=0.0
000162          A(7)=FG2
          C     A(8)=0.0
000164          A(9)=PS
          C     A(10)=GAMMA P
          C     A(11)=0.0
000165          A(12)=MACH
000167          A(13)=PSJIN
000170          A(14)=QSJIN
000172          A(15)=AJ
          C     A(16)=0.0
000173          A(17)=CFG
000175          A(18)=DHE
          C     A(19)=0.0
          C     A(20)=PLUG          NOZZLE TYPE DESIGNATION
          C     A(21)=FLAMIX        MIXED OR NON-MIXED FLOW
          C     A(22)=DMAX
          C     A(23)=DMBASE
          C     A(24)=ZLPLUG
          C     A(25)=ZLBTAL
          C     A(26)=SPACE
          C     A(27)=BASE
          C     A(28)=BTTAB    BOATAIL TABLE INDICATOR
          C     A(29)=THETA
000176          A(30)=XJNI
000200          A(31)=XJBASE
000201          CALL DRAGAB(A,D)
000203          DNOZ=D(1)
000205          DJET=D(2)
000206          DJBASE=D(3)
000210          DJINT=D(4)
000211          BETA=D(5)
000213          DMAX=A(22)
000214          DNOZRF=TAJU1(MACH,DNREFM,DNREFT,  NONREF)*PI8Y4*QSQIN*DMAX**2
000223          FNA=FNRF-DINLET-DNOZ+DNOZRF
000227          SFCOUT=AFTRF/FNA                                        COMPU610
000230          FNCOR=FNA/DELTA                                         COMPU620
000232          AFCOR=AFTRF/(DELTA*RTHETA)                              COMPU630
000234          SFCOOR=AFCOR/FNCOR                                      COMPU635
          C                                                             COMPU640
000236    7777  RETURN                                                  COMPU650
```

```
C002 37        END
          *DECK OUTGO                                    COMPU868
```

SUBPROGRAM LENGTH
003320

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

46	-	000307	200	-	000317	205	-	000021	210	-	000030
7777	-	000236									

EXTERNALS AND TAGS

ATMOS	-	S00100	SQRT	-	S00200	RBAREX	-	S00300	TABU2	-	S00400
PERF	-	S00500	INLDRAG	-	S00600	DRAGAB	-	S00700	TABU1	-	S01000
END	-	S01100									

BLOCK NAMES AND LENGTHS

INS	-	000003	G	-	000001	OUTS	-	000055	MACHN8	-	000172
DNREF	-	000025	NOZARR	-	000050	OUTINL	-	000C12	ENGNO	-	000003

VARIABLE ASSIGNMENTS

A	-	000000006	AE9	-	000310	ALT	-	000001C03	ALTN8	-	000012C04
AOAC	-	000047303	AOEAC	-	000045C03	AOIAC	-	000C46C03	A8	-	000026C03
A9	-	000025C03	BETA	-	000030C03	BY144	-	000272	C	-	000274
COBASE	-	000021C03	COBLO	-	000014C03	COBT	-	000020C03	COBVP	-	000015C03
COINL	-	000016C03	COINT	-	000022C03	COSPL	-	000013C03	CPG	-	000027C03
CON	-	000002301	DELTA	-	000277	DELTA2	-	000304	DME	-	000316
DINLET	-	000012C03	DMAX	-	000317	DNOZ	-	000017C03	DNOZRF	-	000023C03
DNREFM	-	000000005	DNREFT	-	000012C05	EXTRA	-	000051C03	FG	-	000305
FGRP	-	000315	FG1	-	000307	FG2	-	000314	FN	-	000031C03
FNA	-	000003303	FNCOR	-	000036C03	FNRF	-	000006C03	FRAM	-	000007C03
G	-	000000002	MACH	-	000000C01	MACHN8	-	000010C04	MILRF	-	000011C03
NONREF	-	000024005	NAN8	-	000170C04	NYN3	-	000171C04	O	-	000257
OUTINL	-	000000007	PA48	-	000042C03	PIBY4	-	000271	PS	-	000002C03
PSUIR	-	000273	PTS	-	000302	P8PJ	-	000024C03	P8PORF	-	000313
Q	-	000044C03	QSAIN	-	000276	RATIO	-	000311	RF	-	000010C03
RTHETA	-	000300	RTHET2	-	000303	SFCOOR	-	000040C03	SFCOUT	-	000005C03
TA48	-	000041303	TTS	-	000043C03	V	-	000275	W	-	000034C03
WABS	-	000035C03	WFCOR	-	000037C03	WFT	-	000032C03	WFTRF	-	000004C03
W08	-	000306	W08RF	-	000312	W8	-	000024C04	XDBASE	-	000002C10
XDNI	-	000001310	ZZMAC4	-	000301						

START OF CONSTANTS
003240

START OF TEMPORARIES
003254

START OF INDIRECTS
003257

SPACE REQUIRED TO COMPILE
035736

SUBJECT: SUBRØUTINE TABIN

PURPØSE: SUBRØUTIN. TABIN reads the Inlet performance data deck, Cards 3.1 to 3.2.12.

METHØD: The input deck is read. Table 2A is enriched as required to evaluate that table. If inlet capture area is not input it is computed.

USAGE: CALL TABIN

All COMMON blocks in this routine are filled by calling this subprogram.

SUBROUTINES CALLED: SIZINL TABL1 TABL2

TABL22 TABU1

```
      SUBROUTINE TABIN
C     TABIN INPUT TABLES FOR INLET CALCULATIONS
      COMMON/TAB1/TAB1(20),NT1
      COMMON/TAB2A1/ TAB2AM(10),TAB2AA(10,10),TAB2AP(10,10),NTX2A1,
     A               NTY2A1(10)
      COMMON/ENRICH/ ATAB(41,10),PTAB(41,10)
      COMMON/XMMIN/XMMIN
      COMMON/TAB2B/TAB2B(20),NT2B
      COMMON/TAB2C/TAB2C(20),NT2C
      COMMON/TAB2D/TAB2D(20),NT2D
      COMMON/TAB2E/TAB2E(20),NT2E
      COMMON/TAB3/TAB3(120),NTX3,NTY3
      COMMON/TAB4/TAB4(120),NTX4,NTY4
      COMMON/TAB5/TAB5(120),NTX5,NTY5
      COMMON/TAB6A/TAB6A(120),NTX6A,NTY6B
      COMMON/TAB7/TAB7(120),NTX7,NTY7
      COMMON/TAB6B/TAB6B(20),NT6B
      COMMON/AC/AC,ACEAC,AOBYAC,AOBAC,AOIAC
      COMMON/IDESGN/XMDES,WCENGD,WCSECD
      COMMON/XMACHS/XMACHS
      DIMENSION AT(41),PT(41)
    1 FORMAT(*0TABLE NUMBER *A3)
    2 FORMAT(11F7.0)
    3 FORMAT(*1INLET INPUT DECK*5X 8HINPUT AC,5X,5HMACHS,2X,8HMACH DES,
     8*X,6HWC ENG,4X,6HWC SEC /*20X,3F10.3,2F10.1)
      READ (5,2) AC,XMACHS,XMDES,WCENGD,WCSECD
      WRITE(6,3) AC,XMACHS,XMDES,WCENGD,WCSECD
      NO=1H1
      WRITE(6,1)NO
      CALL TABL1(TAB1,10,NT1)
      NO=3H2A
      WRITE(6,1)NO
      CALL TABL22(TAB2AM,10,10,NTX2A1,NTY2A1)
C     BUILD ENRICHED TABLE
      DO 25 I=1,NTX2A1
      N=NTY2A1(I)
      IF (N.EQ.1) GO TO 75
      AMI=TAB2AA(N,I)
      ALO=TAB2AA(1,I)
      DA=.05*(AMI-ALO)
      DAA=.0135666667*(AMI-ALO)
      ATAB(1,I)=ALO
      PTAB(1,I)=TAB2AP(1,I)
      ATAB(41,I)=AMI
      PTAB(41,I)=TAB2AP(N,I)
      A=ALO
      DO 25 K=2,40
      IF (K-11) 22,22,23
   22 A=A+DA
      GO TO 24
   23 A=A+DAA
   24 ATAB(K,I)=A
```

```
000142          PTAB(K,I)=TABJ1(A,TAB2AA(1,I),TAB2AP(1,I),  N)
000154       25 CONTINUE
000160          WRITE(6,5)
000163        5 FORMAT(*0TABLE 2A AS EXPANDED TO 41 POINTS WITH INTERMEDIATE MACH
                 ACJRVES INTERPOLATED AS DIAGNOSTIC AID*)
000163          DO 50 I=1,NTX2A1
000165          WRITE(6,4) TAB2AM(I)
000172          WRITE(6,7) (ATAB(K,I),K=1,41)
000206          WRITE(6,7) (PTAB(K,I),K=1,41)
000222          IF (I.EQ.NTX2A1) GO TO 50
000224          TMACH=0.5*(TAB2AM(I+1)+TAB2AM(I))
000227          DO 40 L=1,41
000231          AT(L)=0.5*(ATAB(L,I+1)+ATAB(L,I))
000241       40 PT(L)=0.5*(PTAB(L,I+1)+PTAB(L,I))
000247          WRITE(6,4) TMACH
000254          WRITE(6,7) AT
000262          WRITE(6,7) PT
000276       50 CONTINUE
000273        4 FORMAT(14),F5.2)
000273        7 FORMAT(9X,11F9.4/(18X,10F9.4))
000273       75 CONTINUE
000273          XMMIN=TAB2AM(1)
000275          WRITE(6,6) XMMIN
000332        6 FORMAT(*0MINIMUM MACH NUMBER FOR INLET DRAG CALCULATIONS*F7.3)
000332          NO=2H2B
000334          WRITE(6,1)NO
000311          CALL TABL1(TAB2B,10,NT2B)
000314          NO=2H2C
000316          WRITE(6,1)NO
000323          CALL TABL1(TAB2C,10,NT2C)
000326          NO=2H2D
000330          WRITE(6,1)NO
000335          CALL TABL1(TAB2D,10,NT2D)
000340          NO=2H2E
000342          WRITE(6,1)NO
000347          CALL TABL1(TAB2E,10,NT2E)
000352          NO=1H3
000354          WRITE(6,1)NO
000361          CALL TABL2(TAB3,10,10,NTX3,NTY3)
000365          NO=1H4
000367          WRITE(6,1)NO
000374          CALL TABL2(TAB4,10,10,NTX4,NTY4)
000400          NO=1H5
000402          WRITE(6,1)NO
000407          CALL TABL2(TAB5,10,10,NTX5,NTY5)
000413          NO=2H6A
000415          WRITE(6,1)NO
000422          CALL TABL2(TAB6A,10,10,NTX6A,NTY6A)
000426          NO=2H6B
000430          WRITE(6,1)NO
000435          CALL TABL1(TAB6B,10,NT6B)
000440          NO=1H7
000442          WRITE(6,1)NO
```

```
      CALL TABL2(TAB7,10,10,NTX7,NTY7)
      IF (AC.LE.0.0) CALL SIZINL
      RETURN
      END
```

SUBPROGRAM LENGTH
000717

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000461	2	-	000465	3	-	000467	4	-	000530
5	-	000512	6	-	000537	7	-	000533	22	-	000130
23	-	000133	24	-	000135	50	-	000270	75	-	000273

EXTERNALS AND TAGS

INPUTC.	-	S00100	OUTPTC.	-	S00200	TABL1	-	S00300	TABL22	-	S00400
TABU1	-	S00500	TABL2	-	S00600	SIZINL	-	S00700	END.	-	S01000

BLOCK NAMES AND LENGTHS

TAB1	-	000325	TAB2A1	-	000335	ENRICH	-	001464	XMMIN	-	000001
TAB2B	-	000025	TAB2C	-	000025	TAB2D	-	000025	TAB2E	-	000025
TAB3	-	000172	TAB4	-	000172	TAB5	-	000172	TAB6A	-	000172
TAB7	-	000172	TAB6B	-	000025	AC	-	000005	IDESGN	-	000003
XMACHS	-	000001									

VARIABLE ASSIGNMENTS

A	-	000715	AC	-	000000C17	AMI	-	000707	ALO	-	000710
AT	-	000562	ATAB	-	000000C03	DA	-	000711	DAA	-	000712
I	-	000705	K	-	000714	L	-	000716	N	-	000706
NO	-	000704	NTX2A1	-	000322C02	NTX3	-	000170C11	NTX4	-	000170C12
NTX5	-	000170C13	NTX6A	-	000170C14	NTX7	-	000170C15	NTY2A1	-	000323C02
NTY3	-	000171C11	NTY4	-	000171C12	NTY5	-	000171C13	NTY6B	-	000171C14
NTY7	-	000171C15	NT1	-	000024C01	NY2B	-	000024C05	NT2C	-	000024C06
NT2D	-	000024C07	NT2E	-	000024C10	NT63	-	000024C16	PT	-	000633
PTA3	-	000632C03	TAB1	-	000000C01	TAB2AA	-	000012C02	TAB2AM	-	000000C02
TAB2AP	-	000150C02	TAB2B	-	000000C05	TAB2C	-	000000C06	TAB2D	-	000000C07
TAB2E	-	000000C10	TAB3	-	000000C11	TAB4	-	000000C12	TAB5	-	000000C13
TAB6A	-	000000C14	TAB6B	-	000000C16	TAB7	-	000000C15	TMACH	-	000715
WCENGD	-	000001C20	WCSEGD	-	000002C20	XMACHS	-	000000C21	XMDES	-	000000C20
XMMIN	-	000000C04									

START OF CONSTANTS
000660

START OF TEMPORARIES
000567

START OF INDIRECTS
000702

SPACE REQUIRED TO COMPILE
037700

SUBJECT: SUBRØUTINE INLDRAG Controls the Calculation of Inlet Performance.

METHØD: After initialization M_0 is interpolated and compared with the minimum Mach number for which inlet drag will be computed and with the start Mach number to determine which inlet mode to use. Low speed mode is computed in INLDRAG: Subroutine AIRBYP computes external-compression mode performance, and subroutine AIRSPL computes mixed-compression mode. In the two latter cases inlet drag coefficients are interpolated and inlet drag determined. The outlet array is loaded and subroutine is complete.

USAGE: CALL INLDRAG (XM, P, WE, WS, DINLET, RF)

XM - Free-stream Mach number

P - Total free-stream pressure LB/FT^2

WE - Engine corrected airflow, primary LB/Sec

WS - Engine corrected airflow, secondary LB/Sec

Output DINLET - Inlet Drag LB

Output RF - Inlet recovery factor

Input from CØMMØN

XMMIN - Minimum Mach for inlet drag calculation

AC - Capture area - ft^2

Inlet Tables 1, 2B, 3, 4 and 5

Output in CØMMØN

ØUTINL (10)

SUBRØUTINES CALLED: AIRBYP AIRSPL AREAF

TABU1 TABU2

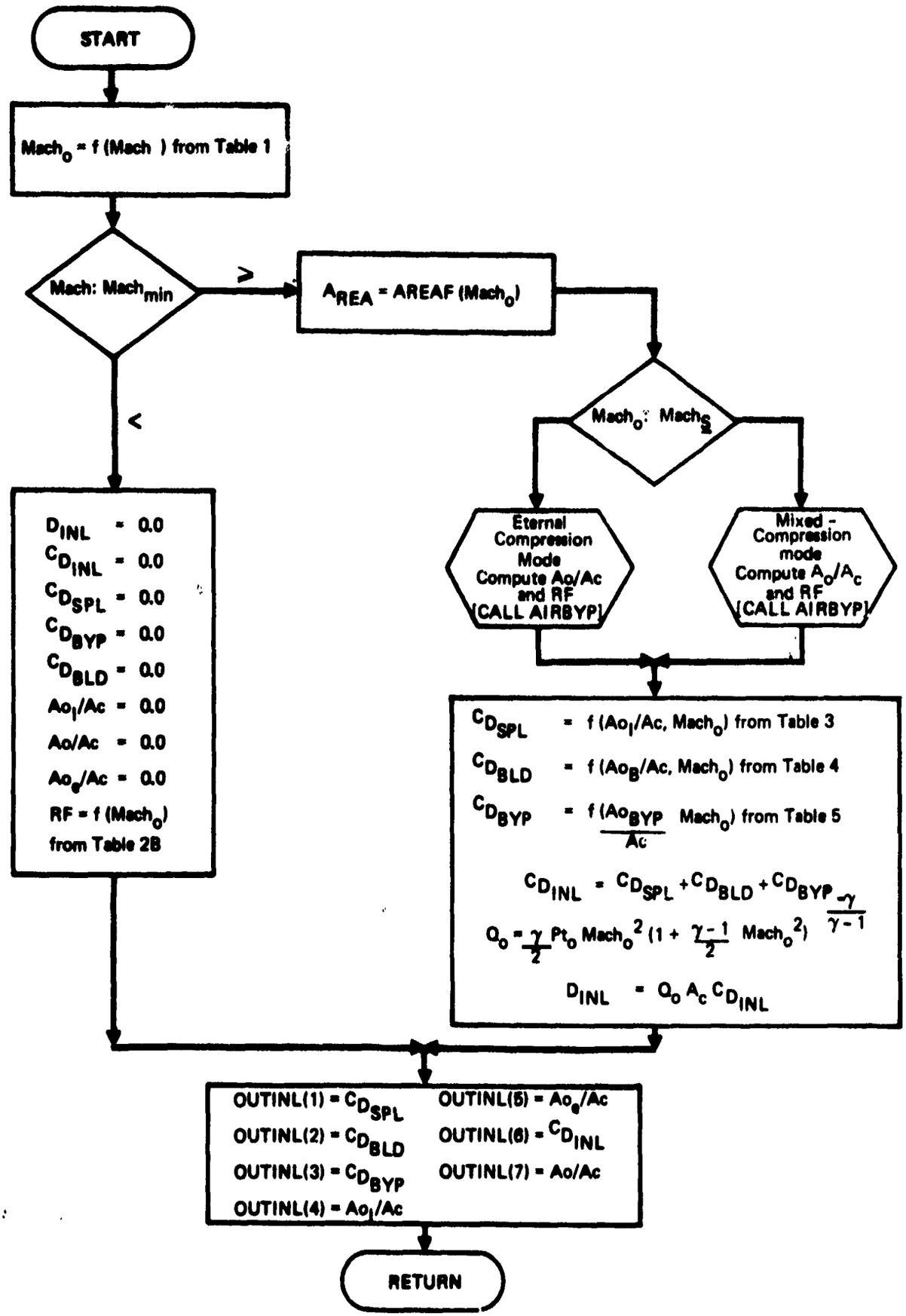


Figure 3: FLOW CHART FOR SUBROUTINE INLDRAG

```
      SUBROUTINE INLDRAG(XM,P,WE,WS,DINLET,RF)
      COMMON/OUTINL/OUTINL(10)
      COMMON/XMACHS/XMACHS
      COMMON/XMMIN/XMMIN
      COMMON/AREAVL/AREA
      COMMON/PT2PTO/PT2PTO
      COMMON/TAB1/TAB1X(10),TAB1Y(10),NT1
      COMMON/TAB2B/TAB2BX(10),TAB2BY(10),NT2B
      COMMON/TAB3/AIACT(10),XM3(10),CDT3(10,10),NTX3,NTY3
      COMMON/TAB4/ABACT(10),XM4(10),CDT4(10,10),NTX4,NTY4
      COMMON/TAB5/AYACT(10),XM5(10),CDT5(10,10),NTX5,NTY5
      COMMON/AC/AC,ACEAC,AYAC,ABAC,AIAC
      COMMON/WC/WCENG,WCSEC
      COMMON/XMACH/XMACH
      COMMON/GAMMA/GAMMA
      COMMON/PT/PT
      COMMON/XMZERO/XMZERO
      COMMON/AJAC/AJAC
      XMACH=XM
      PT=P
      WCENG=WE
      WCSEC=WS
      CDSPL=0.0
      CDBLD=0.0
      CDBYP=0.0
      AIAC=0.0
      AJEAC=0.0
      AJAC=0.0
      XMZERO=TAB01(XMACH,TAB1X,TAB1Y,  NT1)
      IF (XMZERO.LT.XMMIN) GO TO 300
      AREA=AREAF(XMZERO)
      IF (XMZERO.LT.XMACHS) GO TO 100
      CALL AIRSPL
      GO TO 200
  100 CALL AIRBYP
  200 CDSPL=TAB02(AIAC,XMZERO,AIACT,XM3,CDT3,     NTX3,NTY3,10,10)
      CDBLD=TAB02(ABAC,XMZERO,ABACT,XM4,CDT4,     NTX4,NTY4,10,10)
      CDBYP=TAB02(AYAC,XMZERO,AYACT,XM5,CDT5,     NTX5,NTY5,10,10)
      QZERO=(.5*GAMMA*PT*(XMZERO**2)*
     1(1.+((GAMMA-1.)*.5)*(XMZERO**2))**(-GAMMA/(GAMMA-1.))
      DINLET=QZERO*AC*(CDSPL+CDBLD+CDBYP)
      GO TO 400
  300 DINLET=0.0
      PT2PTO=TAB01(XMZERO,TAB2BX,TAB2BY,  NT2B)
  400 RF=PT2PTO
      OUTINL(1)=CDSPL
      OUTINL(2)=CDBLD
      OUTINL(3)=CDBYP
      OUTINL(4)=AIAC
      OUTINL(5)=AJEAC
      OUTINL(6)=CDSPL+CDBLD+CDBYP
      OUTINL(7)=AJAC
```

```
00.162          RETURN
0CJ103          END
```

SUBPROGRAM LENGTH
000201

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
100 - 000052 200 - 000053 300 - 000136 400 - 000143

EXTERNALS AND TABS
TAB01 - S00100 AREAF - S00200 AIRSPL - S00300 AIRBYP - S00400
TAB02 - S00500 RBAREX - S00600 END. - S00700

BLOCK NAMES AND LENGTHS
OUTIAL - 000012 XMACHS - 000001 XMMIN - 000001 AREAVL - 000001
PT2PTO - 000001 TAB1 - 000025 TAB2B - 000025 TAB3 - 000172
TAB4 - 000172 TAB5 - 000172 AC - 000005 MC - 000002
XMACH - 000001 GAMMA - 000001 PT - 000001 XMZERO - 000001
ACAC - 000001

VARIABLE ASSIGNMENTS
ABAC - 000003C13 ABACT - 000000C11 AC - 000005C13 AIAC - 000004C13
AIACT - 000003C10 AREA - 000000C04 AYAC - 000002C13 AYACT - 000003C12
ACAC - 000006C21 AYEAC - 000001C13 COBOLD - 000176 COBYP - 000177
COSPL - 000175 COT3 - 000024C10 COT4 - 000024C11 COT5 - 000024C12
GAMMA - 000000C16 NTX3 - 000170C10 NTX4 - 000170C11 NTX5 - 000170C12
NTY3 - 000171C10 NTY4 - 000171C11 NTY5 - 000171C12 NT1 - 000024C06
NT2B - 000024C07 OUTIN. - 000000C01 PT - 000000C17 PT2PTO - 000000C05
QZERO - 000200 TAB1X - 000000C06 TAB1Y - 000012C06 TAB2BX - 000000C07
TAB2BY - 000012C07 WCENG - 000000C14 WCSEC - 000001C14 XMACH - 000000C15
XMACHS - 000000C02 XM1IN - 000000C03 XMZERO - 000000C20 XM3 - 000012C10
XM4 - 000012C11 XM5 - 000012C12

START OF CONSTANTS
000104

START OF TEMPORARIES
000157

START OF INDIRECTS
000175

SPACE REQUIRED TO COMPILE
035310

SUBJECT: SUBRØUTINE SIZINL

PURPØSE: SUBRØUTINE SIZINL computes inlet capture area.

USAGE: CALL SIZINL

Inputs in CØMMØN/IDESIGN/ design Mach and airflow.

Tables 1, 2B and 2C.

Output: AC ft^2

SUBJECT: FUNCTIØN AREAF

PURPØSE:
$$AREAF = \frac{.013858 \left(1 + \frac{\gamma - 1}{2} Mach^2 \right)^{\frac{\gamma + 1}{2(\gamma - 1)}}}{Mach\sqrt{\gamma}}$$

USAGE: A = AREAF (XMACH)

XMACH local Mach number

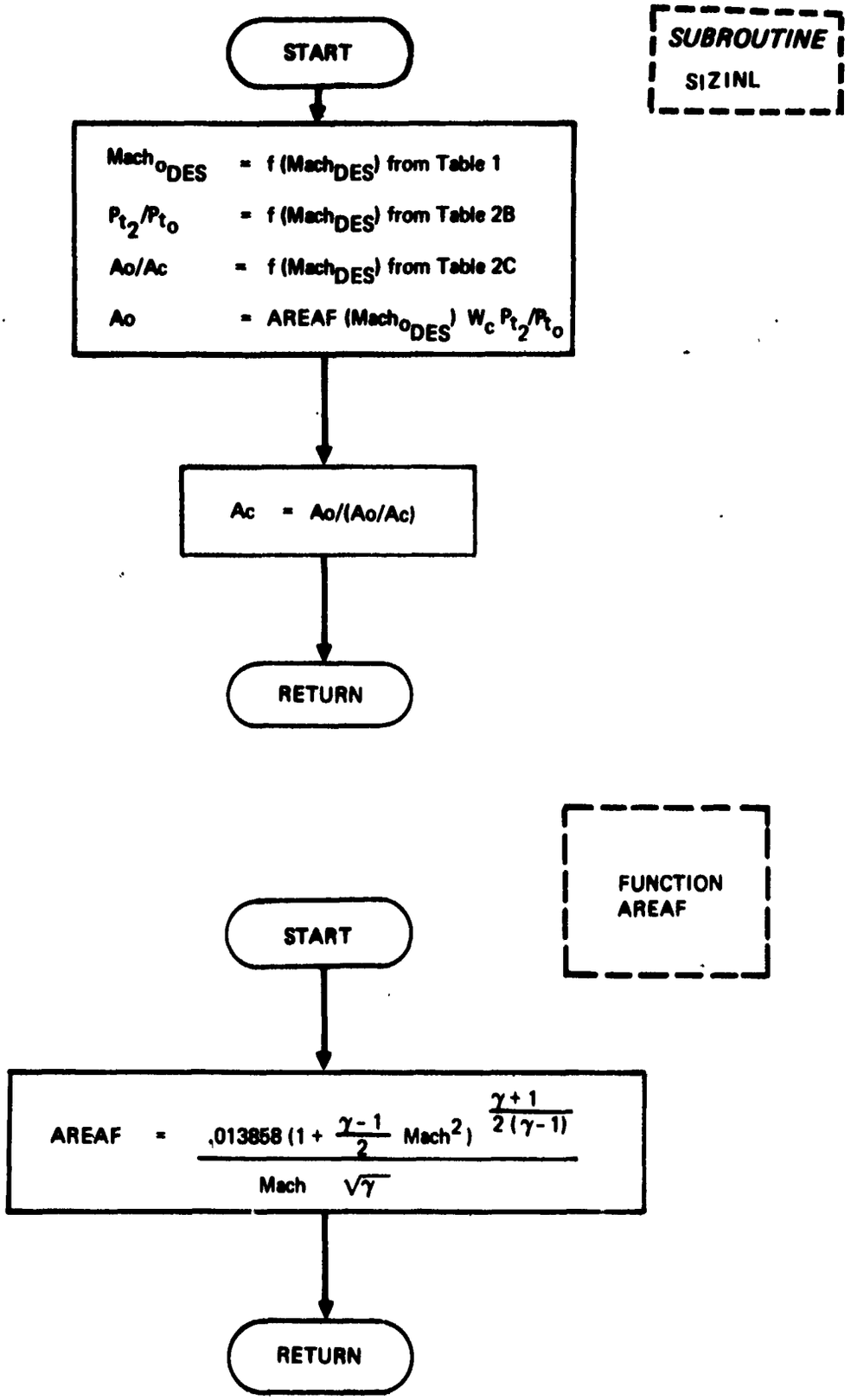


Figure 4: FLOW CHART FOR SUBROUTINE SIZINL AND FUNCTION AREAF

```
                SUBROUTINE SIZING
0000 02         COMMON/IDESGN/XMDES,WCENGD,WCSECD
0000 02         COMMON/TAB1/TAB1X(10),TAB1Y(10),NT1
0000 02         COMMON/TAB2B/TAB2BX(10),TAB2BY(10),NT2B
0000 02         COMMON/TAB2C/TAB2CX(10),TAB2CY(10),NT2C
0000 02         COMMON/AC/AC,ACEAC,A0BYAC,AJBAC,AJIAC
0000 02         XMDES=TABU1(XMDES,TAB1X,TAB1Y,  NT1)
0000 15         PTP2RC=TABU1(XMDES,TAB2BX,TAB2BY,  NT2B)
0000 11         AJACRC=TABU1(XMDES,TAB2CX,TAB2CY,  NT2C)
0000 15         AJ=AREAF(XMDES)*(WCENGD+WCSECD)*PTP2RC
0000 23         AC=AJ/AJACRC
0000 26         WRITE(6,1) AC,XMDES,WCENGD,WCSECD,XMDES,PTP2RC,AJACRC,AJ
0000 51       1 FORMAT(*0AC =* F6.3,10X,7E12.4)
0000 51         RETURN
0000 52         END
```

SUBPROGRAM LENGTH
000065

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
1 - 000055

EXTERNALS AND TABS
TAB01 - 000100 AREAF - 000200 OUTPTC - 000300 END. - 001401

BLOCK NAMES AND LENGTHS
IDESGN - 000003 TAB1 - 000025 TAB2B - 000025 TAB2C - 000025
AC - 000005

VARIABLE ASSIGNMENTS
AC - 000000005 AC - 000064 ADACRC - 000063 NT1 - 000024C02
NT2B - 000024003 NT2C - 000024C04 PTP2RC - 001062 TAB1X - 000000C02
TAB1Y - 000012C02 TAB2BX - 000000C03 TAB2BY - 000012C03 TAB2CX - 000000C04
TAB2CY - 000012C04 WCSAGD - 000001C01 WCSECD - 000002C01 XMDES - 000003C01
XMODES - 000061

START OF CONSTANTS
000053

START OF TEMPORARIES
000056

START OF INDIRECTS
000061

SPACE REQUIRED TO COMPILE
00540C

SUBJECT: SUBRØUTINE AIRBYP

PURPØSE: SUBRØUTINE AIRBYP Computes recovery and mass flow ratios for external compression mode inlets.

METHØD: AIRBYP matches the recovery and mass flow from Table 2A to that obtained from function DEMAND. Table 2A was enriched to 41 points per array when input by SUBRØUTINE TABIN. AIRBYP first interpolates in this table to develop a curve of RF = f (A_0/A_C) at the input Mach number.

The 41st point of this table represents the choked flow point, in Maximum (A_0/A_C). DEMAND is called to compute (A_0/A_C) for the RF at the choked point. This A_0/A_C is compared to the A_0/A_C of the choked point. If the A_0/A_C from DEMAND is greater than the maximum A_0/A_C then the inlet is choked and RF must be found such that DEMAND(RF) = $A_0/A_{C_{MAX}}$. A Newton-Raphson iteration is used to solve this case. Otherwise the inlet is not choked and a solution for A_0/A_C exists less than the maximum. A Regula Falsi iteration is used to match the recovery and mass flow.

In either case buzz and distortion limits are checked and the other mass flow ratios computed.

USAGE: CALL AIRBYP

Inputs in COMMON include Mach number, air flow, capture area and inlet tables. Other COMMON blocks are output.

SUBPRØGRAMS:

DEMAND	FACINT	IFIND
TABU1	TABU2	WARNING

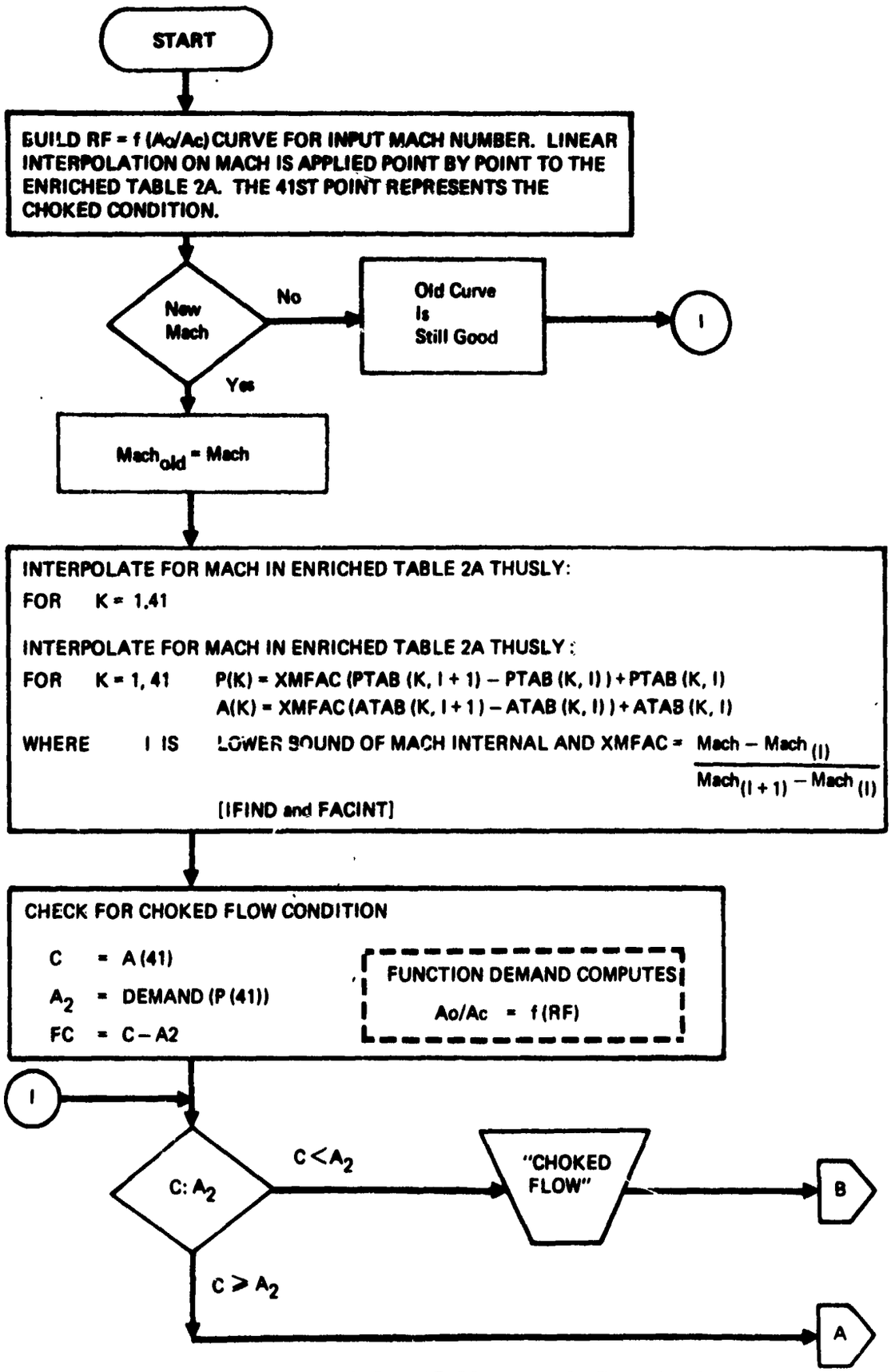
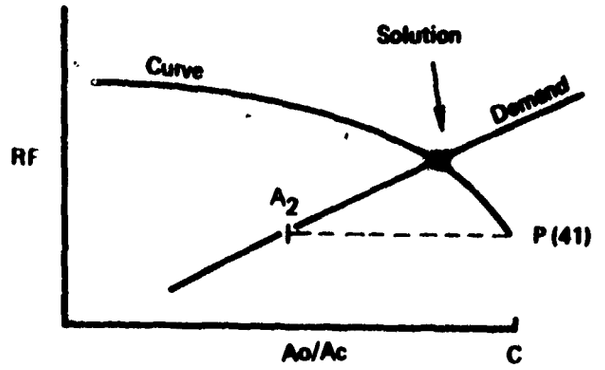


Figure 5: FLOW CHART FOR SUBROUTINE AIRBYP



REGULA FALSI ITERATION

TO FIND INTERSECTION

NON-CHOKED FLOW

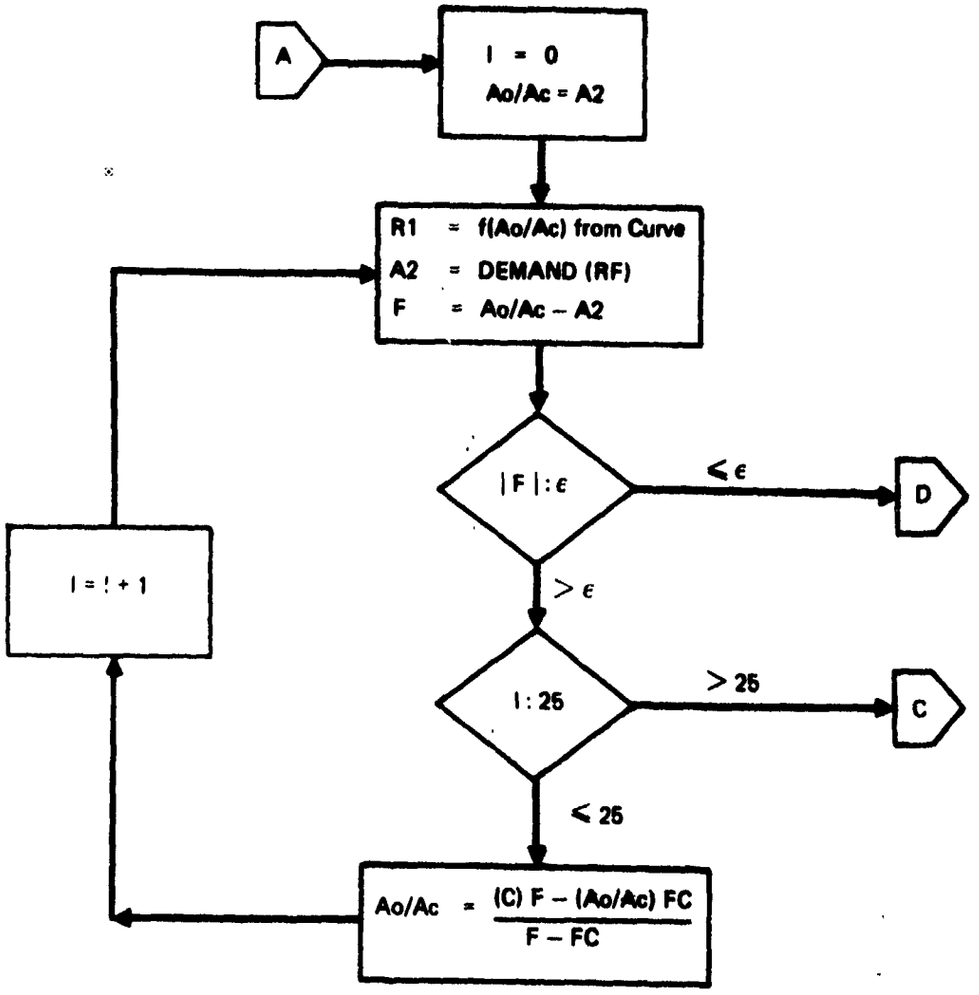
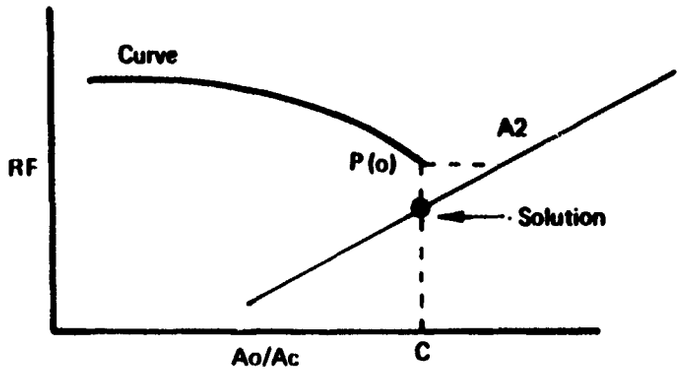


Figure 5: FLOW CHARTS FOR SUBROUTINE AIRBYP (Cont)



NEWTON–RAPHSON ITERATION TO FIND INTERSECTION

CHOKED FLOW

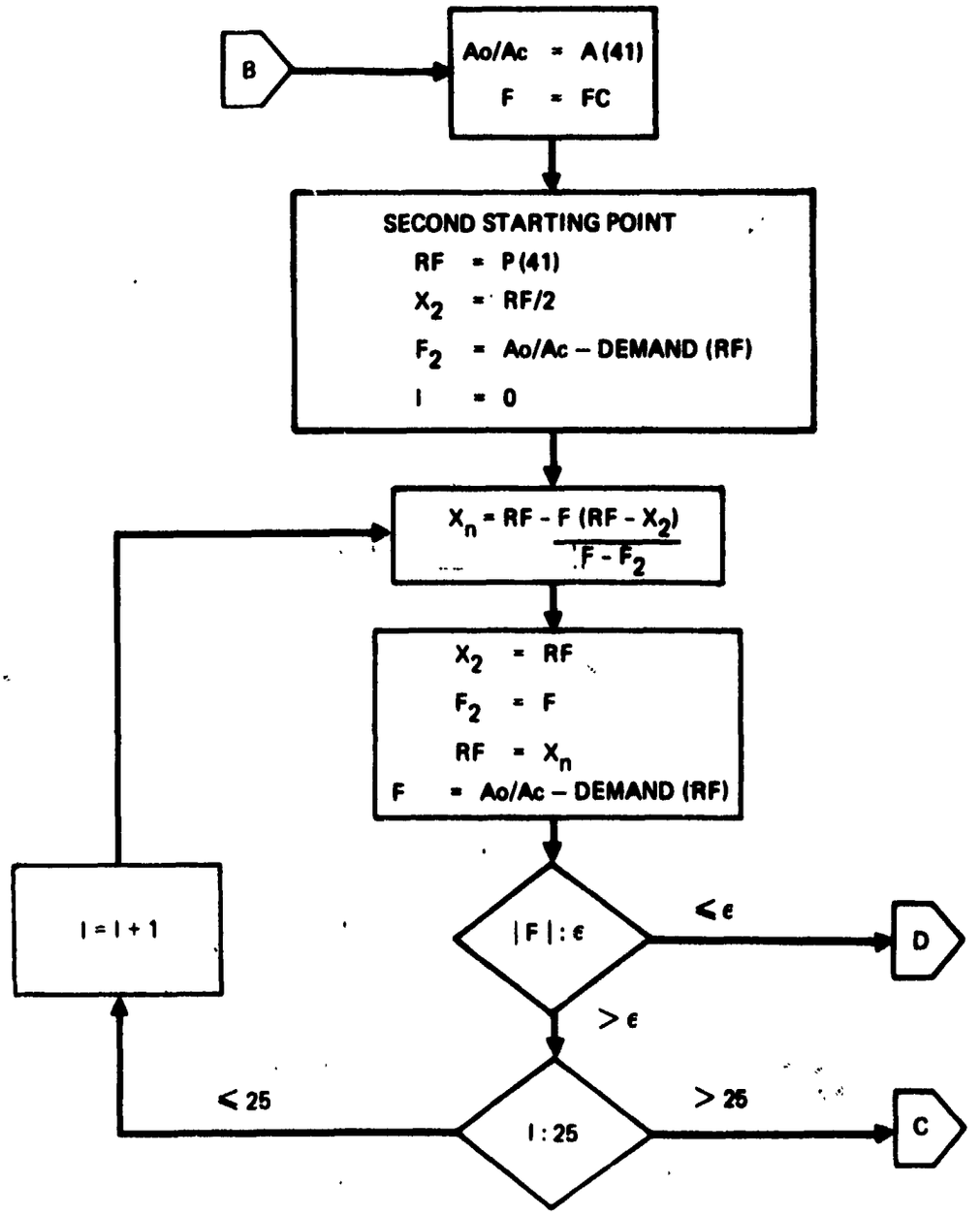


Figure 5: FLOW CHART FOR SUBROUTINE AIRBYP (Cont)

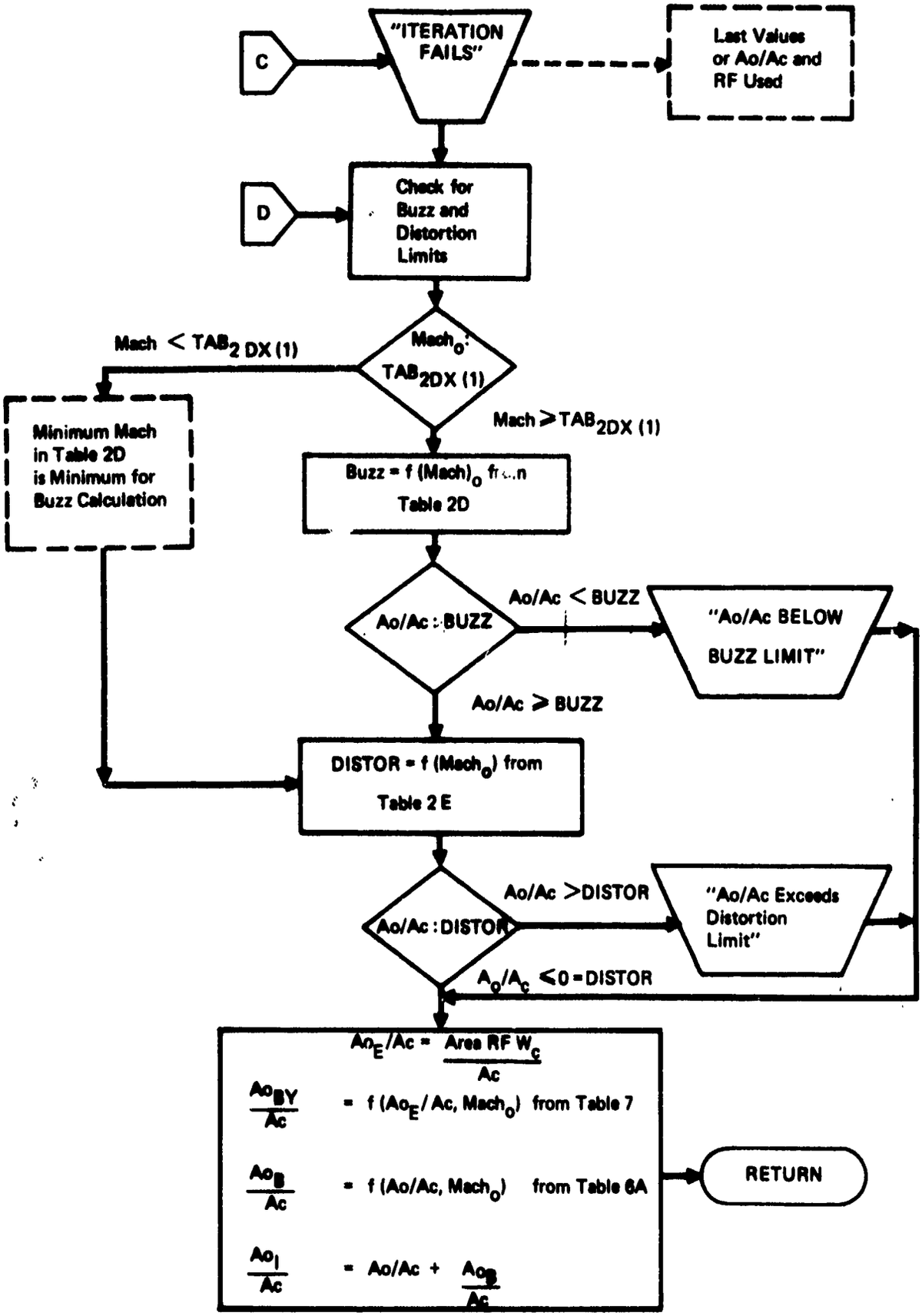


Figure 5: FLOW CHART FOR SUBROUTINE AIRBYP (Concluded)

```
                SUBROUTINE AIRBYP
0000 02         COMMON/PT2PT0/PT2PT0
0000 02         COMMON/AREAVL/AREA
0000 02         COMMON/MC/MCENG,MCSEC
0000 02         COMMON/GAMMA/GAMMA
0000 02         COMMON/XMZERO/XMZERO
0000 02         COMMON/TAB2A1/ XM2A1(10),ARRAY1(200),NTX2A1,NTY2A1(10)
0000 02         COMMON/ENRICH/ ATAB(41,10),PTAB(41,10)
0000 02         COMMON/AC/AC,ACEAC,AOBYAC,AOBAC,AOIAC
0000 02         COMMON/TAB6A/TAB6X(10),TAB6Y(10),TAB6Z(10,10),NTX6,NTY6
0000 02         COMMON/TAB7 /TAB7X(10),TAB7Y(10),TAB7Z(10,10),NTX7,NTY7
0000 02         COMMON/TAB2D/TAB2DX(10),TAB2DY(10),NT2D
0000 02         COMMON/TAB2E/TAB2EX(10),TAB2EY(10),NT2E
0000 02         COMMON/XMACH/XMACH
0000 02         COMMON/PT/PT
0000 02         COMMON/AOAC/AOAC
0000 02         DIMENSION A(41),P(41)
0000 02         INTEGER SEARCH
0000 02         DATA TOL/.0005/
0000 02         DATA OLDM1/-999./
                C     BUILD PT2/PT0 = F(AO/AC) AT XMZERO
0000 02         NA=41
0000 03         IFLAG=IFIND(XMZERO,XM2A1,NTX2A1,I)
0000 07         XMFAC=FACINT(XMZERO,XM2A1(I),IFLAG)
0000 13         N1=NTY2A1(I)
0000 15         IF (N1.EQ.1) GO TO 2500
0000 17         IF (XMZERO.EQ.OLDM1) GO TO 530
0000 21         OLDM1=XMZERO
0000 21         IF (XMFAC) 100,300,100
0000 22     100 N2=NTY2A1(I+1)
0000 24         DO 200 K=1,41
0000 26         P(K)=XMFAC*(PTAB(K,I+1)-PTAB(K,I))+PTAB(K,I)
0000 36         A(K)=XMFAC*(ATAB(K,I+1)-ATAB(K,I))+ATAB(K,I)
0000 44     200 CONTINUE
0000 45         GO TO 500
0000 46     300 DO 400 K=1,41
0000 50         P(K)=PTAB(K,I)
0000 54         A(K)=ATAB(K,I)
0000 56     400 CONTINUE
                C     SEARCH FOR INTERSECTION
                C     FIND SOLUTION INTERVAL
0000 61     500 C=A(NA)
0000 63         A2=DEMAND(P(NA))
0000 66         FC=C-A2
0000 70         IF (C.LT.A2) GO TO 2000
0000 71         ICOUNT=0
0000 72         AOAC=A2
                C     REGULA FALSI METHOD
0000 73     675 PT2PT0=TABU1(AOAC,A,P  ,NA)
0000 77         A2=DEMAND(PT2PT0)
0001 01         F=AOAC-A2
0001 03         IF (ABS(F).LE.TOL) GO TO 3000
```

```
000106          IF (ICOUNT.GT.25) GO TO 2900
000111          ICOUNT=ICOUNT+1
000112          AOAC=(C*F-AOAC*FC)/(F-FC)
000117          GO TO 675
              C     SOLUTION FOR PT2/PTC SUCH THAT DEMAND=MAX AO/AC
000120       2000 AOAC=A(NA)
000122          CALL WARNING
000123          WRITE(6,4)
000127        4 FORMAT(* CHOKED FLOW CONDITIONS*)
000127          F=FC
000131          PT2PTC=P(NA)
000133          X2=.5*PT2PTC
000134          F2=AOAC-DEMAND(X2)
000140          ICOUNT=3
000141       2100 XNEXT=PT2PTC-F*(PT2PTC-X2)/(F-F2)
000147          X2=PT2PTC
000150          F2=F
000150          PT2PTC=XNEXT
000152          F=AOAC-DEMAND(PT2PTC)
000155          IF (ABS(F).LT.TOL) GO TO 3000
000160          IF (ICOUNT.GT.25) GO TO 2900
000164          ICOUNT=ICOUNT+1
000165          GO TO 2100
000165       2500 PT2PTC=XNFAC*(PTAB(1,I+1)-PTAB(1,I))+PTAB(1,I)
000175          GO TO 3000
000175       2900 CALL WARNING
000176          XDEM=DEMAND(PT2PTC)
000231          WRITE(6,3) PT2PTC,AOAC,XDEM
000212        3 FORMAT(* ITERATION TO MATCH PT2/PTC AND AO/AC DID NOT CONVERGE
             APT2/PTC*F8.4, 5X*AO/AC*F8.4,5X,*DEMAND*F8.4)
000212       3000 IF (XMZERO.LT.TAB2DX(1)) GO TO 3010
000215          BUZZLM=TABU1(XMZERO,TAB2DX,TAB2DY,  NT2D )
000221          IF(AOAC.GE.BUZZLM) GO TO 3011
000223          CALL WARNING
000224          WRITE(6,1) AOAC,BUZZLM
000234        1 FORMAT(* AO/AC BELOW BUZZ LIMIT.  AO/AC*F8.4,5X*BUZZ LIMIT*F8.4)
000234          GO TO 3020
000235       3010 DISTOR=TABU1(XMZERO,TAB2EX,TAB2EY,  NT2E)
000241          IF (AOAC.LE.DISTOR) GO TO 3020
000243          CALL WARNING
000244          WRITE(6,2) AOAC,DISTOR
000254        2 FORMAT(* AO/AC EXCEEDS DISTORTION LIMIT.  AO/AC*F8.4,5X,*DISTORTIO
             1N LIMIT* F8.4)
000254       3020 AOEAC=AREA          *PT2PTC*MCENG/AC
000260          AOBYAC=TABU2(ACEAC,XMZERO,TAB7X,TAB7Y,TAB7Z,    NTX7,NTY7,10,10)
000271          AOBAC=TABU2(AOAC,XMZERO,TAB6X,TAB6Y,TAB6Z,    NTX6,NTY6,10,10)
000302          AOIAC=AOAC+AOBAC
000304          RETURN
000304          END
```

SUBPROGRAM LENGTH
000521

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000330	2	-	000337	3	-	000314	4	-	000307
100	-	000022	300	-	000046	500	-	000051	675	-	000073
2000	-	000120	2100	-	000141	2500	-	000155	2900	-	000175
3000	-	000212	3010	-	000235	3020	-	000250			

EXTERNALS AND TAGS

IFIND	-	S00100	FACINF	-	S00200	DEMAND	-	S00300	TABU1	-	S00400
MARKING	-	S00500	OUTPTC.	-	S00600	TABU2	-	S00700	END.	-	S01000

BLOCK NAMES AND LENGTHS

PTRPTR	-	000001	AREAVL	-	000001	MC	-	000002	GAMMA	-	001001
XMZERO	-	000001	TAB2A1	-	000535	ENRICH	-	001464	AC	-	000005
TAB6A	-	000172	TAB7	-	000172	TAB2C	-	000025	TAB2E	-	000025
XMACH	-	000001	PT	-	000001	AGAC	-	000001			

VARIABLE ASSIGNMENTS

A	-	000352	AC	-	000000C10	AREA	-	000000C12	ARRAY1	-	000012C06
ATAB	-	000000C07	AGAC	-	000000C17	ADBAC	-	000003C10	ADBYAC	-	000002C10
AGEAC	-	000001C13	AGIAC	-	000004C10	A2	-	000537	BUZZLM	-	000517
C	-	000500	DISTOR	-	000520	F	-	000512	FC	-	000510
F2	-	000514	I	-	000501	ICOUNT	-	000511	IFLAG	-	000500
K	-	000535	NA	-	000477	NTX2A1	-	000322C06	NTX6	-	000170C11
NTX7	-	000170C12	NTY2A1	-	000523C06	NTY6	-	000171C11	NTY7	-	000171C12
NTZ0	-	000024C13	NTZE	-	000024C14	N1	-	000503	N2	-	000504
OLDMJ	-	000470	P	-	000423	PTA3	-	000632C07	PTZERO	-	000000C01
SEARCH	-	000470	TAB20X	-	000000C13	TAB20Y	-	000012C11	TAB2EX	-	000000C14
TAB2EY	-	000012C14	TAB5X	-	000000C11	TAB6Y	-	000012C11	TAB6Z	-	000024C11
TAB7X	-	000000C12	TAB7Y	-	000012C12	TAB7Z	-	000024C12	TOL	-	000475
WORKNG	-	000000C03	XDEM	-	000516	XMFAC	-	000502	XMZERO	-	000000C05
XM2A1	-	000000C06	XNEXT	-	000515	X2	-	000513			

START OF CONSTANTS
000335

START OF TEMPORARIES
000350

START OF INDIRECTS
000352

SPACE REQUIRED TO COMPILE
037130

42

SUBJECT: SUBRØUTINE AIRSPL

PURPØSE: SUBRØUTINE AIRSPL computes recovery and mass flow ratios for mixed-compression mode inlets.

METHØD: The various mass flow ratios are computed from the input airflow and by interpolation in Tables 6B and 2C. Recovery comes from Table 2B. If bypass mass flow is negative; recovery is recomputed so that the bypass mass flow is zero. A message stating that the inlet is undersized results.

USAGE: CALL AIRSPL

Inputs in CØMMØN include Mach number, air flow, capture area, and inlet tables. Other CØMMØN blocks are output.

SUBPRØGRAMS: TABUl WARNING

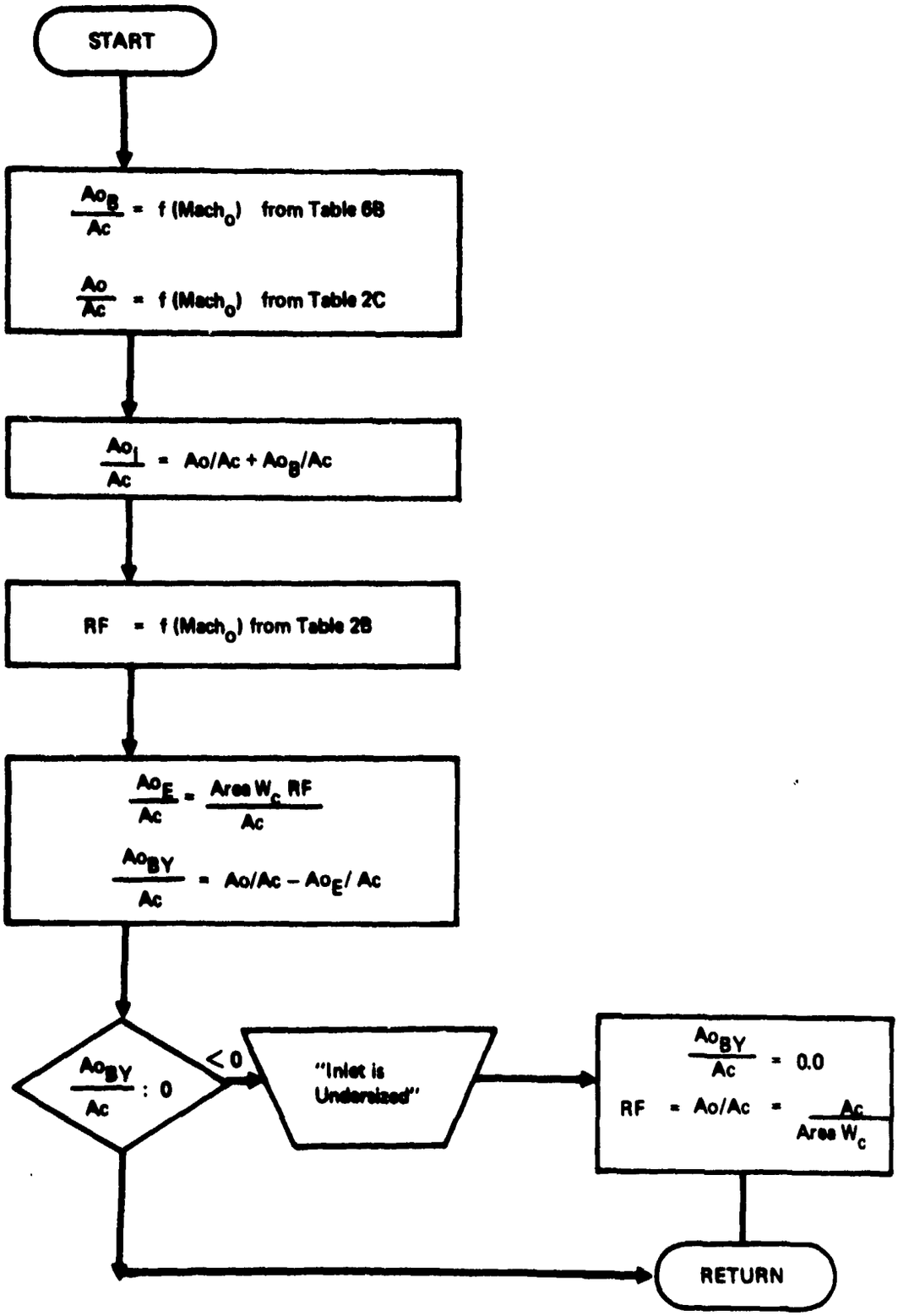


Figure 6: FLOW CHART FOR SUBROUTINE AIRSPL

```
                SUBROUTINE AIRSPL
0J0002          COMMON/PT2PTO/PT2PTO
0000J2          COMMON/AREAVL/AREA
0000J2          COMMON/XMACH/XMACH
0000J2          COMMON/PT/PT
0000J2          COMMON/XMZERO/XMZERO
0000J2          COMMON/AC/AC,ACEAC,AOBVAC,AOBAC,AOIAC
0000J2          COMMON/WC/WCENG,WCSEC
0000J2          COMMON/GAMMA/GAMMA
0000J2          COMMON/TAB6B/TAB6BX(10),TAB6BY(10),NT6B
0000J2          COMMON/TAB2B/TAB2BX(10),TAB2BY(10),NT2B
0000J2          COMMON/TAB2C/TAB2CX(10),TAB2CY(10),NT2C
0000J2          COMMON/TAB2E/TAB2EX(10),TAB2EY(10),NT2E
0000J2          COMMON/TAB2D/TAB2DX(10),TAB2DY(10),NT2D
0000J2          COMMON/AJAC/AOAC
0J0002          AOBAC=TAB01(XMZERO,TAB6BX,TAB6BY,  NT6B)
0000J5          AOEAC=TAB01(XMZERO,TAB2CX,TAB2CY,  NT2C)
0000J1          AOIAC=AOAC+AOBAC
0000J4      20  PT2PTO=TAB01(XMZERO,TAB2BX,TAB2BY,  NT2B)
0000J7          AOEAC=AREA          *(WCENG+WCSEC)*PT2PTO/AC
0000J4          AOBVAC=AOAC-AOEAC
0000J5          IF (AOBVAC.GE.0.) GO TO 30
0000J7          CALL WARNING
0000J0          PSAVE=PT2PTO
0000J1          AOBVAC=0.
0000J2          PT2PTO=AOAC*(AC/AREA          /(WCENG+WCSEC))
0000J7          WRITE(6,1) AOAC,AOEAC,PSAVE,PT2PTO
0000J2        1 FORMAT(* INLET IS UNDERSIZED FOR OPERATION WITH THE SCHEDULED SPIL
               ALAGE AND BLEED*/5X,*AO/AC*F7.4,5X,*AOE/AC*F7.4,5X,*RECOVERY REDUCE
               BD FROM*F7.4,3H TO,F7.4)
0000J2       30 RETURN
0000J3          END
```

SUBPROGRAM LENGTH
000077

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
1 - 000056 20 - 000014 30 - 000052

EXTERNALS AND TAGS
TAB01 - S00100 WARNING- S00200 OUTPTC.- S00300 END. - S00400

BLOCK NAMES AND LENGTHS
PT2PTC - 000001 AREAVL - 000001 XMACH - 000001 PT - 000001
XMZERO - 000001 AC - 000005 MC - 000002 GAMMA - 000001
TAB0B - 000025 TAB2B - 000025 TAB2C - 000025 TAB2E - 000025
TAB2J - 000025 AOAC - 000001

VARIABLE ASSIGNMENTS
AC - 000000C06 AREA - 000000C02 AOAC - 000000C16 AOBAC - 000003C06
AOBYAC - 000002C06 AOEAC - 000001C06 AOIAC - 000004C06 NT2B - 001024C12
NT2C - 000024C13 NT6B - 000024C11 PSAVE - 000076 PT2PTB - 000000C01
TAB2BX - 000000C12 TAB2BY - 000012C12 TAB2CX - 000001C13 TAB2CY - 000012C13
TAB2JX - 000000C15 TAB2JY - 000012C15 TAB2EX - 000000C14 TAB2EY - 000012C14
TAB6BX - 000000C11 TAB6BY - 000012C11 WCENG - 000000C17 WCSEC - 000001C07
XMZERO - 000000C05

START OF CONSTANTS
000054

START OF TEMPORARIES
000076

START OF INDIRECTS
000076

SPACE REQUIRED TO COMPILE
000000

SUBJECT: SUBRØUTINE DRG

PURPØSE: SUBRØUTINE DRG computes bottail drag for convergent-divergent nozzle.

METHØD: The built in nozzle data tables are defined in the DATA statements of this routine. Boattail angle is computed; then Mach is interrogated. If Mach is less than .9 the subsonic procedure, SUBBT, is used. Similarly if Mach is greater than or equal to 1.0 the supersonic procedure is used. If Mach is in the range from .9 to 1.0, then the subsonic procedure is used with Mach equal to .9 and the supersonic procedure with Mach equal to 1.0. Final results are obtained by interpolating between the two sets of results using Mach as the independent variable. This provides a smooth transition between the two Mach regimes.

USAGE: CALL SUBRØUTINE (DMDG, DBDJ, LDJ, EMF, EMJD, PTPF, THETA, GAM, ICØN)

DMDJ	Ratio of maximum to jet diameter
DBDJ	Ratio of base to jet diameter
LDJ	Ratio of length to jet diameter
EMF	Freestream Mach number
EMJD	Jet design Mach number
PTPF	Ratio of Jet total to free-stream static pressure
THETA	Boattail trailing edge angle - degrees
GAM	Ratio of specific heats
ICØN	= 0 circular are boattail
	= 1 conical boattail

Output in CØMMØN/A/

SUBPRØGRAMS: ATAN SUBBT SUPBT

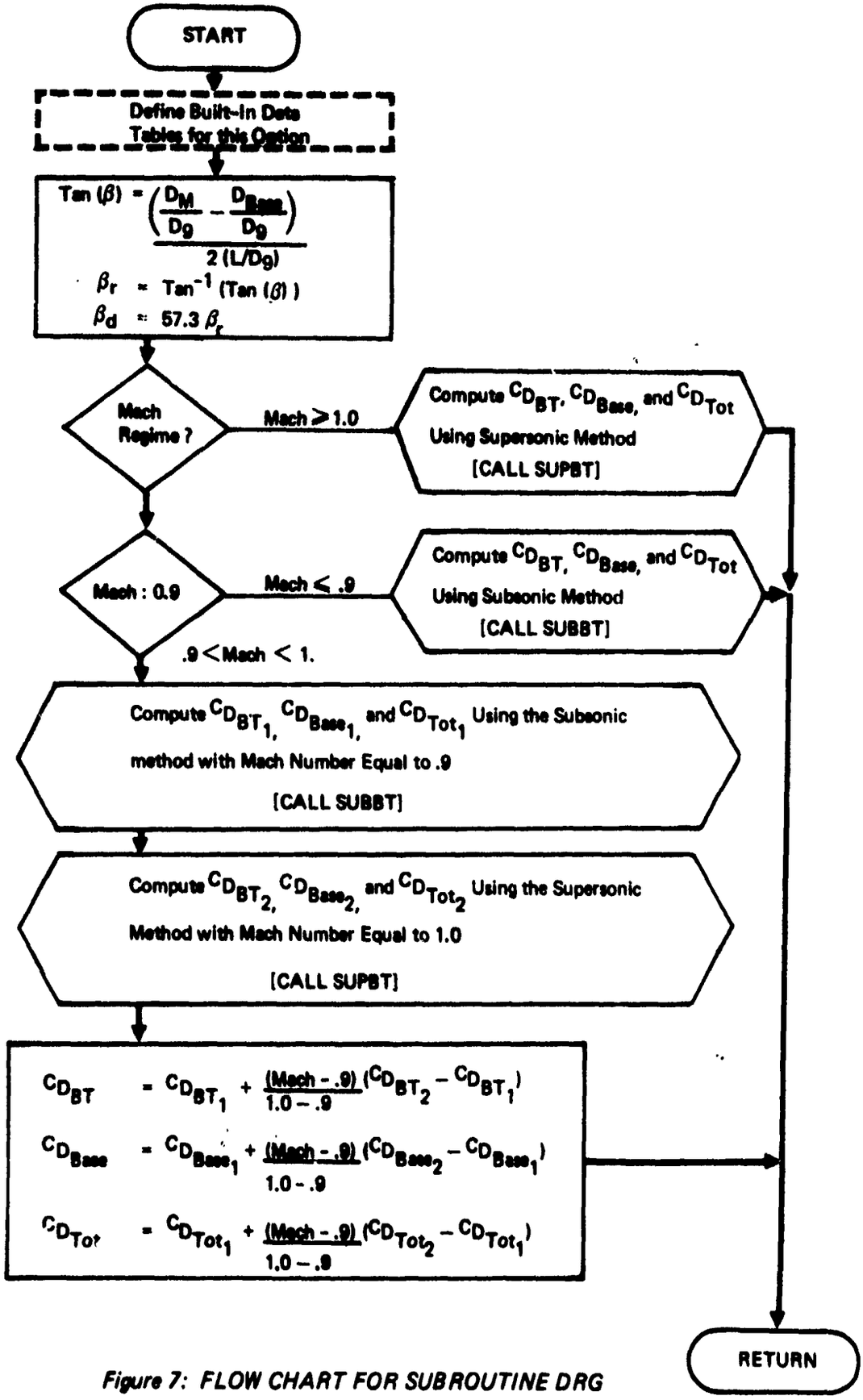


Figure 7: FLOW CHART FOR SUBROUTINE DRG

```
                SUBROUTINE DRG(DMOJ,OBOJ,LOJ,EMF,EMJD,PTPF,THETA,GAM,ICON)

0000 14         COMMON/A/CD,CDBS,CUBT,BETAD

0000 14         COMMON/DRGTB/NT1,TB1(3),TBF1(3),NT2,TB2(20),TBF2(20),NT3,TB3(10),
                1               TBF3(10),NTX4,NTY4,TBX4(5),TBY4(11),TBF4(5,11),NT5,
                2               TB5(5),TBF5(6),NTX6,NTY6,TBX6(5),TBY6(7),TBF6(5,7),
                3               NT7,TB7(7),TBF7(7),NT8,TB8(5),TBF8(5),NTX9,NTY9,
                4               TBX9(5),TBY9(9),TBF9(5,9),NTX10,NTY10,TBX10(5),
                5               TBY10(7),TBF10(5,7),NTX11,NTY11,TBX11(5),TBY11(6),
                6               TBF11(5,6),NT12A,TB12A(10),TBF12A(10),NT12B,TB12B(10)
                7              ,TBF12B(10),NT13,TB13(10),TBF13(10)

0000 14         DIMENSION TBP4(55),TBP6(35),TBP9(45),TBP10(35),TBP11(30)
0000 14         EQUIVALENCE(TBP4 (1),TBF4(1,1))
0000 14         EQUIVALENCE(TBP6 (1),TBF6(1,1))
0000 14         EQUIVALENCE(TBP9 (1),TBF9(1,1))
0000 14         EQUIVALENCE(TBP10(1),TBF10(1,1))
0000 14         EQUIVALENCE(TBP11(1),TBF11(1,1))
0000 14         REAL LOJ

                C       TABLE 1 - B=F(M)
0000 14         DATA NT1/ 3 /
0000 14         DATA TB1  / 1.00,1.57,2.60 /
0000 14         DATA TBF1 / 1.40, .67, .33 /

                C       TABLE 2 - B=F(C)
0000 14         DATA NT2 / 20 /
0000 14         DATA TB2  / .06, .08, .10, .15, .20, .25, .30, .35, .40, .45,
                1           .50, .60, .70, .80, .90,1.00,1.50,2.00,2.50,3.00 /
0000 14         DATA TBF2 /2.15,2.05,1.90,1.63,1.45,1.35,1.20,1.11,1.05,1.00,
                1          1.00,1.00,1.00,1.15,1.21,1.27,1.65,2.05,2.40,2.75 /

                C       TABLE 3 - K=F(PB/PF)
0000 14         DATA NT3 / 10 /
0000 14         DATA TB3  / 1.0 ,2.0 ,3.0 ,4.0 ,5.0 ,6.0 ,7.0 ,8.0 ,9.0 ,10.0 /
0000 14         DATA TBF3 / .820,.575,.380,.245,.190,.165,.145,.135,.125,.120 /

                C       TABLE 4 - DDBZ=F(THETA,DB/DM)
0000 14         DATA NTX4,NTY4 / 5,11 /
0000 14         DATA TBX4                    /   3.0  ,5.6  ,8.0  ,16.0 ,24.0 /
0000 14         DATA TBY4 /.00,.10,.20,.30,.40,.50,.60,.70,.75,.80,.90/
0000 14         DATA TBP4 /  .0000,  .0000,  .0000,  .0000,  .0000,              .00
                A            .0040,  .0005,  .0025,  .0055,  .0095,              .10
                B            .0065,  .0015,  .0050,  .0120,  .0190,              .20
                C            .0015,  .0030,  .0085,  .0215,  .0295,              .30
                D            .0030,  .0052,  .0140,  .0325,  .0400,              .40
                E            .0050,  .0110,  .0245,  .0430,  .0510,              .50
                F            .0100,  .0215,  .0350,  .0535,  .0615,              .60
                G            .0200,  .0320,  .0450,  .0645,  .0720,              .70
                H            .0250,  .0340,  .0510,  .0700,  .0760,              .75
                I            .0235,  .0300,  .0510,  .0700,  .0770,              .80
```

```
     J            .0125,  .0161,  .0300,  .0410,  .0460/                    .90

C       TABLE 5 - DCD8/DCP8=F(THETA)
      DATA NT5 / 6 /
      DATA TB5  / 0.,5.0,10.0,15.0,20.0,25.0 /
      DATA TBF5 / 0.,-.09,-.19,-.36,-.67,-1.1 /

C       TABLE 6 - DCP8=F(THETA,PTP/P)
      DATA NTX6,NTY6 / 5,7 /
      DATA TBX6                 /   3.0  ,5.6  ,8.0  ,16.0 ,24.0  /
      DATA TBY6 / 1.0,2.0,3.0,4.0,5.0,6.0,7.0 /
      DATA TBP6 /  5*-.025,  5*-.030,  5*-.046,  5*-.080,                  1.0-4.0
     A             -.147,  -.142,  -.138,  -.120,  -.100,                  5.0
     B             -.194,  -.184,  -.175,  -.142,  -.115,                  6.0
     C             -.225,  -.210,  -.200,  -.160,  -.120/                  7.0

C       TABLE 7 - DCP8/D(DJ2/DdDM)=F(PTP/P)
      DATA NT7 / 7 /
      DATA TB7  / 1.00,2.00,3.00,4.00,5.00,6.00,7.00 /
      DATA TBF7 /  .18, .18, .24, .48, .76,1.00,1.34 /

C       TABLE 8 - DCPd/D(DJ/D8)=F(THETA)
      DATA NT8 / 5 /
      DATA TB8  / 0.0,10.,15.,20.,25. /
      DATA TBF8 / .05,.09,.10,.09,.04 /

C       TABLE 9 - CP8/C=F(D8DM,THETA)
      DATA NTX9,NTY9 / 5,9 /
      DATA TBX9                 /   3.0  ,5.6  ,8.0  ,16.0 ,24.0 /
      DATA TBY9 / .1,.2,.3,.4,.5,.6,.7,.8,.9 /
      DATA TBP9 /  -.130,  -.040,  .010,  2*.190,                          .10
     A             -.130,  -.040,  .010,  2*.185,                          .20
     B             -.130,  -.040,  .010,  2*.175,                          .30
     C             -.130,  -.040,  .010,  2*.150,                          .40
     D             -.130,  -.040,  .010,  2*.140,                          .50
     E             -.130,  -.040,  .010,  2*.105,                          .60
     F             -.130,  -.075,  -.025,  2*.075,                         .70
     G             -.130,  -.085,  -.042,  2*.032,                         .80
     H             -.140,  -.105,  -.075,  2*-.040 /                       .90

C       TABLE 10 - CP8ZK=F(D8/DM,THETA)
      DATA NTX10,NTY10 / 3,7 /
      DATA (TBX10(I),I=1,3)           /   3.0  ,5.6  ,8.0  /
      DATA TBY10 / .3,.4,.5,.6,.7,.8,.9 /
      DATA TBP10 /  -.050, .000, .075, -.060, .010, .075, -.060, .000,
     A               .075, -.060, .000, .075, -.050, .000, . 75, .000,
     B             -.040, -.015, -.065, -.055, -.050 /

C       TABLE 11 - CD=F(EMF,THETA)
      DATA NTX11,NTY11 / 5,6 /
      DATA TBX11                        /     7.0 ,8.0 ,10.0,14.0,20.0 /
      DATA TBY11 /  .400,.800,.850,.900,.925,.950 /
      DATA TBP11 / .016,  .023,  .030,  .034,  .046,                       .400
```

```
                A          .016,  .023,  .030,  .034,  .046,                    .800
                B          .018,  .024,  .032,  .038,  .050,                    .850
                C          .023,  .030,  .040,  .055,  .070,                    .900
                D          .033,  .040,  .054,  .078,  .097,                    .925
                E          .050,  .067,  .090,  .125,  .170 /                   .950

      C         TABLE 12A - PTPF=F(CD)  6.LT.BETA.LE.12 DEGREES
0000 14         DATA NT12A / 10 /
0000 14         DATA TB12A /2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0 /
0000 14         DATA TBF12A/-0.002,0.0,0.0005,-.0021,-.0075,-.0125,-.0175,-.0280,
     1                -.0385,-.0495 /
      C         TABLE 12B - PTPF=F(CD)  BETA.GT.12 DEGREES
0000 14         DATA NT12B / 10 /
0000 14         DATA TB12B /2.0,2.5,3.0,3.5,4.0,4.5,5.0,6.0,7.0,8.0/
0000 14         DATA TBF12B/-.003,0.,.0005,-.0035,-.0070,-.0070,-.0110,-.020,
     1                -.0295,.0400 /

      C         TABLE 13 - PB/PF=F(PTP/PF)
0000 14         DATA NT13 / 7 /
0000 14         DATA TB13  / 1.5,2.0,2.5,3.0,3.5,4.0,4.5 /
0000 14         DATA TBF13 / .95,.86,.79,.73,.69,.67,.65 /

0000 14         DATA RAD/57.29578/

0000 14         TANB=.5*(DMDJ-DBDJ)/LDJ
0000 17         BETA=ATAN(TANB)
0000 21         BETAD=RAD*BETA
0000 22         IF(EMF .GE. 1.)GO TO 100

      C         SUBSONIC BOATTAIL DRAG
0000 30         IF(EMF .LE. .9)GO TO 50
0000 32         EMS=EMF
0000 33         EMF=.9
0000 34         CALL SUBBT(DMDJ,DBDJ,EMF,PTPF,THETA,ICON,GAM)
0000 42         CDBT1=CDBT
0000 44         CDBS1=CDBS
0000 45         CD1=CD
0000 47         EMF=1.0
0000 53         CALL SUPBT(DMDJ,DBDJ,EMF,EMDJ,PTPF,GAM,TAN3)
0000 61         CDBT2=CDBT
0000 63         CDBS2=CDBS
0000 64         CD2=CD
0000 66         EMF=EMS
0000 72         CDBT=CDBT1+10.*(EMF-.9)*(CDBT2-CDBT1)
0001 01         CDBS=CDBS1+10.*(EMF-.9)*(CDBS2-CDBS1)
0001 10         CD=CD1+10.*(EMF-.9)*(CD2-CD1)
0001 17         GO TO 500
0001 20      50 CONTINUE
0001 20         CALL SUBBT(DMDJ,DBDJ,EMF,PTPF,THETA,ICON,GAM)
0001 26         GO TO 500

      C         SUPERSONIC BOATTAIL AND BASE DRAG
```

```
000132      100 CONTINUE
000132          CALL SUPBT(DMDJ,DBDJ,EMF,EMJJ,PTPF,GAM,TANB)

000140      500 CONTINUE
000140          RETURN
000141          END
****0- ****************************
```

SUBPROGRAM LENGTH
000174

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
50 - 000120 100 - 000132 500 - 000140

EXTERNALS AND TAGS
ATAN - S00100 SUBBT - S00200 SUPBT - S00300 END. - S00400

BLOCK NAMES AND LENGTHS
A - 000004 DRST3 - 000676

VARIABLE ASSIGNMENTS

EETA	-	000164	dETAU	-	000003C01	CD	-	C00000C01	CDBS	-	C03001C01
CDBS1	-	000167	CDBS2	-	000172	CDBT	-	000002C01	CDBT1	-	000166
CDBT2	-	000171	CD1	-	000176	CD2	-	000173	EMS	-	000165
GAM	-	000001	ICON	-	000002	NTX10	-	000443C02	NTX11	-	003524C02
NTX4	-	000105C02	NTX6	-	000233C02	NTX9	-	000346C02	NTY10	-	000444C02
NTY11	-	000525C02	NTY4	-	000106C02	NTY5	-	000234C02	NTY9	-	000347C02
NT1	-	000303C02	NT12A	-	000577C02	NT12B	-	000624C02	NT13	-	003651C02
NT2	-	000307C02	NT3	-	000060C02	NT5	-	000216C02	NT7	-	000314C02
NT9	-	000333C02	RAD	-	000162	TAN3	-	000163	TBF1	-	000064C02
TBF10	-	000461C02	TBF11	-	000541C02	TBF12A	-	000612C02	TBF12B	-	000637C02
TBF13	-	000664C02	TBF2	-	000034C02	TBF3	-	000073C02	TBF4	-	000127C02
TBF5	-	000225C02	TBF6	-	000251C02	TBF7	-	000324C02	TBF8	-	000341C02
TBF9	-	000366C02	TBP10	-	000461C02	TBP11	-	000541C02	TBP4	-	000127C02
TBP6	-	000251C02	TBP9	-	000366C02	TBX10	-	000445C02	TBX11	-	000526C02
TBX4	-	000107C02	TBX5	-	000235C02	TBX9	-	000350C02	TBY10	-	000452C02
TBY11	-	000533C02	TBY4	-	000114C02	TBY6	-	000242C02	TBY9	-	000355C02
TB1	-	000301C02	TB12A	-	000600C02	TB12B	-	000625C02	TB13	-	000652C02
TB2	-	000310C02	TB3	-	000061C02	TB5	-	000217C02	TB7	-	000315C02
TB9	-	000334C02	THETA	-	000000						

START OF CONSTANTS
000142

START OF TEMPORARIES
000152

START OF INDIRECTS
000162

SPACE REQUIRED TO COMPILE
00330

D-********VARIABLES EXCEED VALUES IN DATA STATEMENT
000142

53

SUBJECT: SUBRØUTINE CDCØNV

PURPØSE: SUBRØUTINE CDCØNV moniters the convergent-divergent nozzle boattail drag computation.

METHØD: CDCØNV computes the required input values for SUBRØUTINE DRG from the TEM-333 inputs. If the supersonic procedure is to be used i.e., Mach $\geq$ 1.0, these inputs include the design Mach number of the nozzle which is solved for by iteration. DRG is called; then boattail drag computed from the CD obtained.

Note: The set DRG, SUBBT, and SUPBT were in existence prior to TEM-333, hence the incorporation of this routine into the logic.

USAGE: CALL CDCØNV

Input through CØMMØN/ABIN/ and CØMMØN/AMAX/
Output includes D_S for interference routine
Flags PLUG = 0.0; BTTAB = 0.0 causes this subroutine to be called.

SUBPRØGRAMS: AEXHST DRG SQRT WARNING

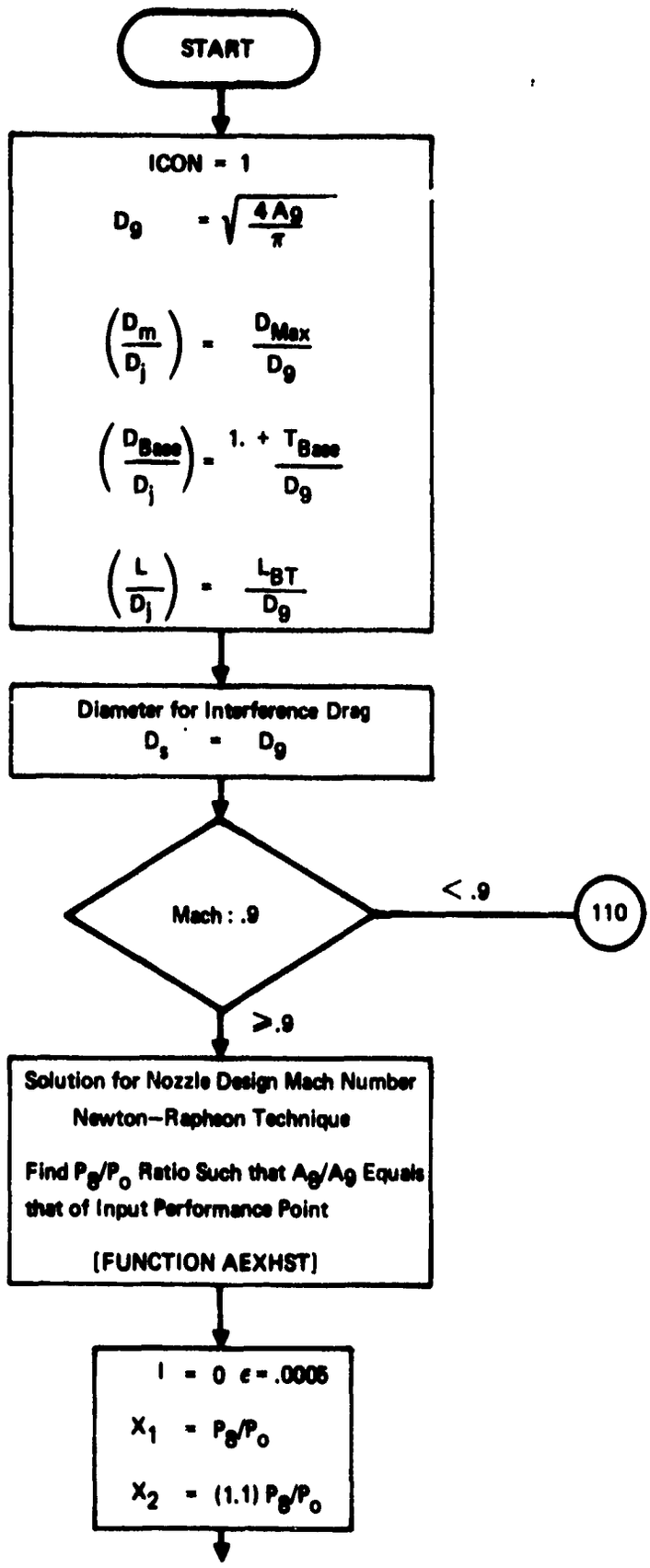


Figure 8: FLOW CHART FOR SUBROUTINE CDCONV

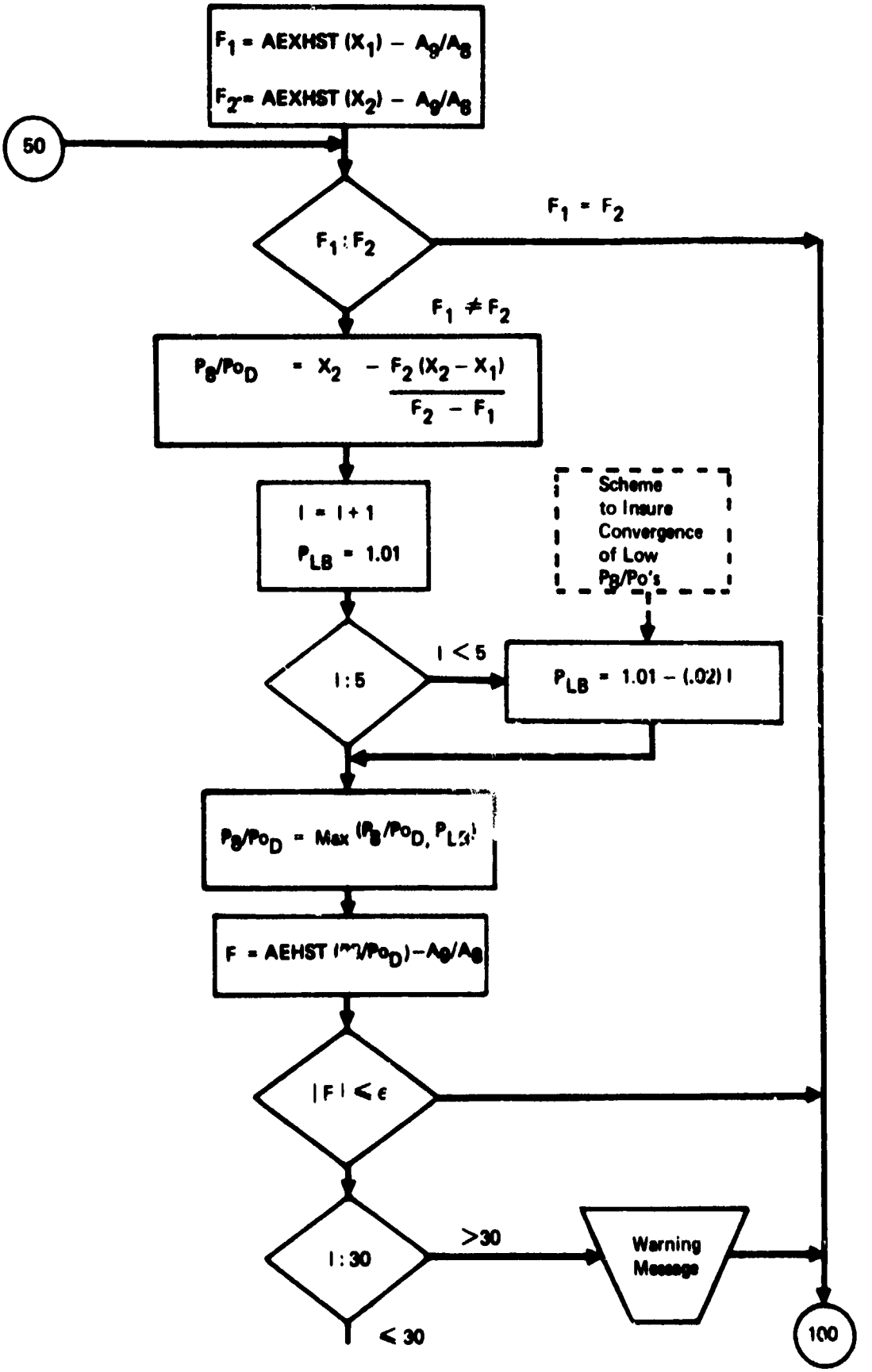


Figure 8: FLOW CHART FOR SUBROUTINE CDCONV (Cont)

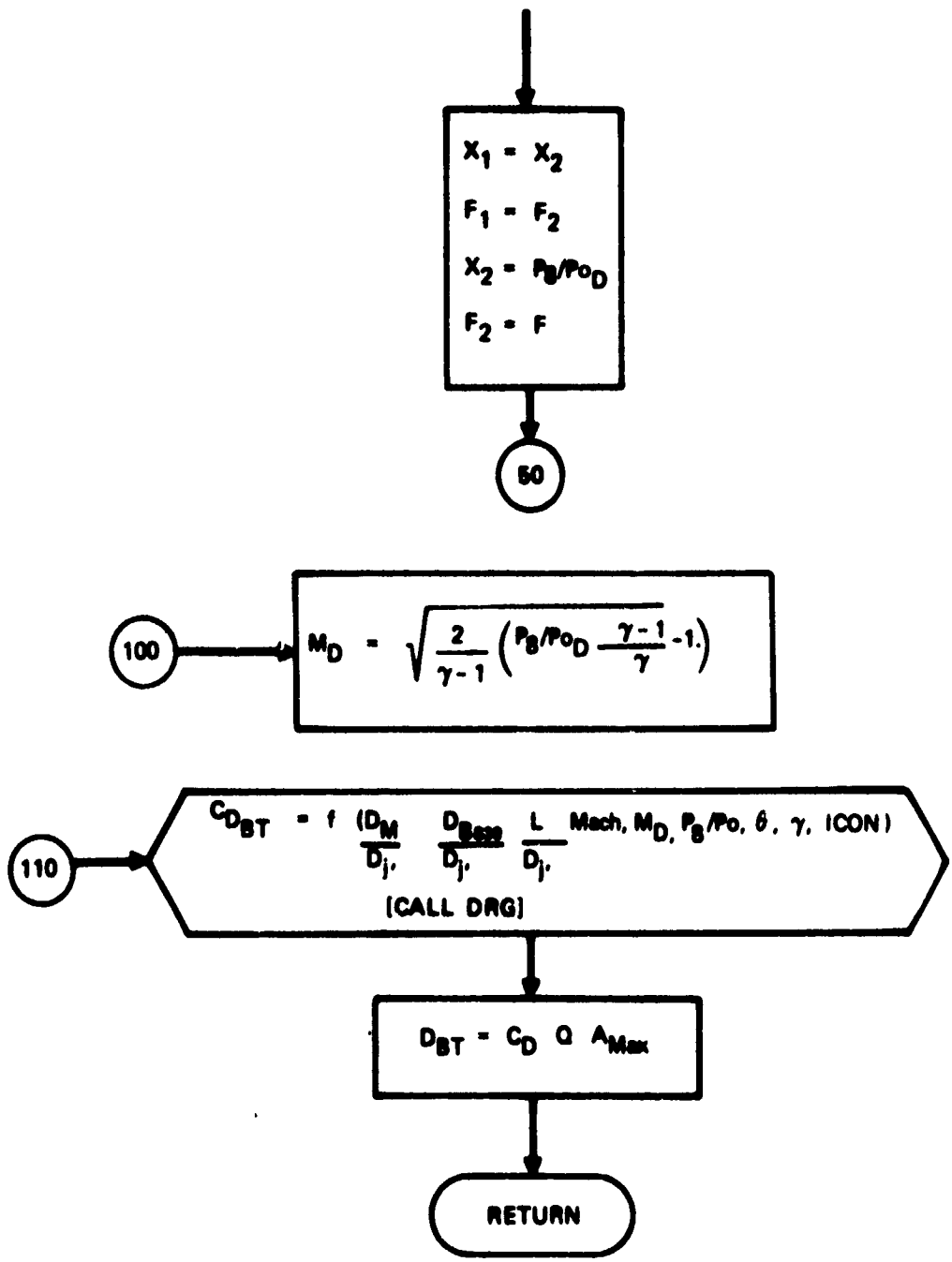


Figure 8: FLOW CHART FOR SUBROUTINE CDCONV (Concluded)

```
      SUBROUTINE COCONV
      COMMON/DSPACE/DSPACE
      COMMON/A/CO,A(3)
      COMMON/AMAX/AMAX
      COMMON/ABINP/ AE8, A8, AE18, A18, P7QO, P17QO, FGIP, FGIF, PC,
     A              GAMMAP, GAMMAF, XM, PAM8, Q, A9, A19, CFG, DMEP,
     B              DMEF, PLUG, FLAMIX, OMAX, THICKB, ZLPLUG, ZLBTAL,
     C              S, ABASE, BTTA8, THETA
     D,             FUTURE(11), NVAR
      COMMON/ABURAG/ DBTAIL, DNI, DBASE
      TOL=.0005
      ICON=1
      D8=SQRT(A8/.785)
      DSPACE=D8
      DMDJ=DMAX/D8
      DBDJ=1.0+THICKB/D8
      ZLDJ=ZLBTAL/D8
      A9A8=A9/A8
      P7QODS=P7QO
      IF (XM.LT.9) GO TO 110
      I=0
      X1=P7QO
      F1=AEXMST(1.0,GAMMAP,X1)-A9A8
      X2= 1.1*P7QO
      F2=AEXMST(1.0,GAMMAP,X2)-A9A8
   50 IF (F2.EQ.F1) GO TO 100
      P7QODS=X2-F2*(X2-X1)/(F2-F1)
      I=I+1
      PLIMIT=1.01
      IF (I.LT.5) PLIMIT=1.10-FLOAT(I)*.02
      P7QODS=AMAX1(P7QODS,PLIMIT)
      F=AEXMST(1.0,GAMMAP,P7QODS)-A9A8
      IF (ABS(F).LE.TOL) GO TO 100
      IF (I.GT.30) GO TO 90
      X1=X2
      F1=F2
      X2=P7QODS
      F2=F
      GO TO 50
   90 CALL WARNING
      WRITE(6,1) P7QODS
    1 FORMAT(* ITERATION FOR P8/P0 DESIGN FAILED TO CONVERGE.* F8.4,* US
     AED TO COMPUTED NOZZLE DESIGN EXIT MACH NUMBER*)
  100 EMDJ=SQRT(2./(GAMMAP-1.)*(   P7QODS)**((GAMMAP-1.)/GAMMAP)-1.0))
  110 CONTINUE
      CALL DRG(DMDJ,DBDJ,ZLDJ,XM,EMDJ,P7QO,THETA,GAMMAP,ICON)
      DBTAIL=DJ*Q*AMAX
      RETURN
      END
```

SUBPROGRAM LENGTH
000220

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000160	50	-	000043	90	-	000110	100	-	000117
110	-	000133									

EXTERNALS AND TAGS

SQRT	-	S00100	AEXMST	-	S00260	WARNING	-	S00300	OUTPTC.	-	S00400
RBAREX.	-	S00500	ORG	-	S00600	END.	-	S00700			

BLOCK NAMES AND LENGTHS

OSPACE	-	000001	A	-	000004	AMAX	-	000001	ABINP	-	000051
ABDRAG	-	000003									

VARIABLE ASSIGNMENTS

A	-	000001C02	AMAX	-	000000C03	A8	-	000031C04	A9	-	000016C04
A9I0	-	000205	CD	-	000000C02	DBDJ	-	000203	DBTAIL	-	000000C05
DMAX	-	000025C04	DMDJ	-	000202	DSPACE	-	000000C01	D9	-	000201
EMJJ	-	000217	F	-	000215	FUTURE	-	000035C04	F1	-	000211
F2	-	000213	GAMMAP	-	000011C04	I	-	000207	ICON	-	000200
PLIMIT	-	000214	PTJOBS	-	000216	P7QQ	-	000034C04	P7QOOS	-	000206
Q	-	000019C04	THETA	-	000034C04	THICKB	-	000025C04	TOL	-	000177
XM	-	000013C04	X1	-	000210	X2	-	000212	ZLBTAL	-	000030C04
ZLOJ	-	000204									

START OF CONSTANTS
000150

START OF TEMPORARIES
000174

START OF INDIRECTS
000177

SPACE REQUIRED TO COMPILE
035000

SUBJECT: SUBRØUTINE PLUGMX

PURPØSE: SUBRØUTINE PLUGMX computes boattail drag for a plug nozzle, mixed flow.

METHØD: Boattail angle is computed from the maximum diameter, exhaust diameter, and plug length. Then Mach is checked and either the subsonic or supersonic method applied. Input tables 4.2.2 and 4.2.3 support the supersonic procedure. Boattail drag is returned.

USAGE: CALL SUBRØUTINE PLUGMX

Input from CØMMØN/ABIN/ and CØMMØN/AMAX/
Output includes D_S for interference routine

Flags set such that: PLUG = 1.0

FLWMIX = 0.0

BTTAB = 0.0

Will cause this routine to be called

SUBPRØGRAMS: AEXHST ATAN SQRT

TABU1 TABU2

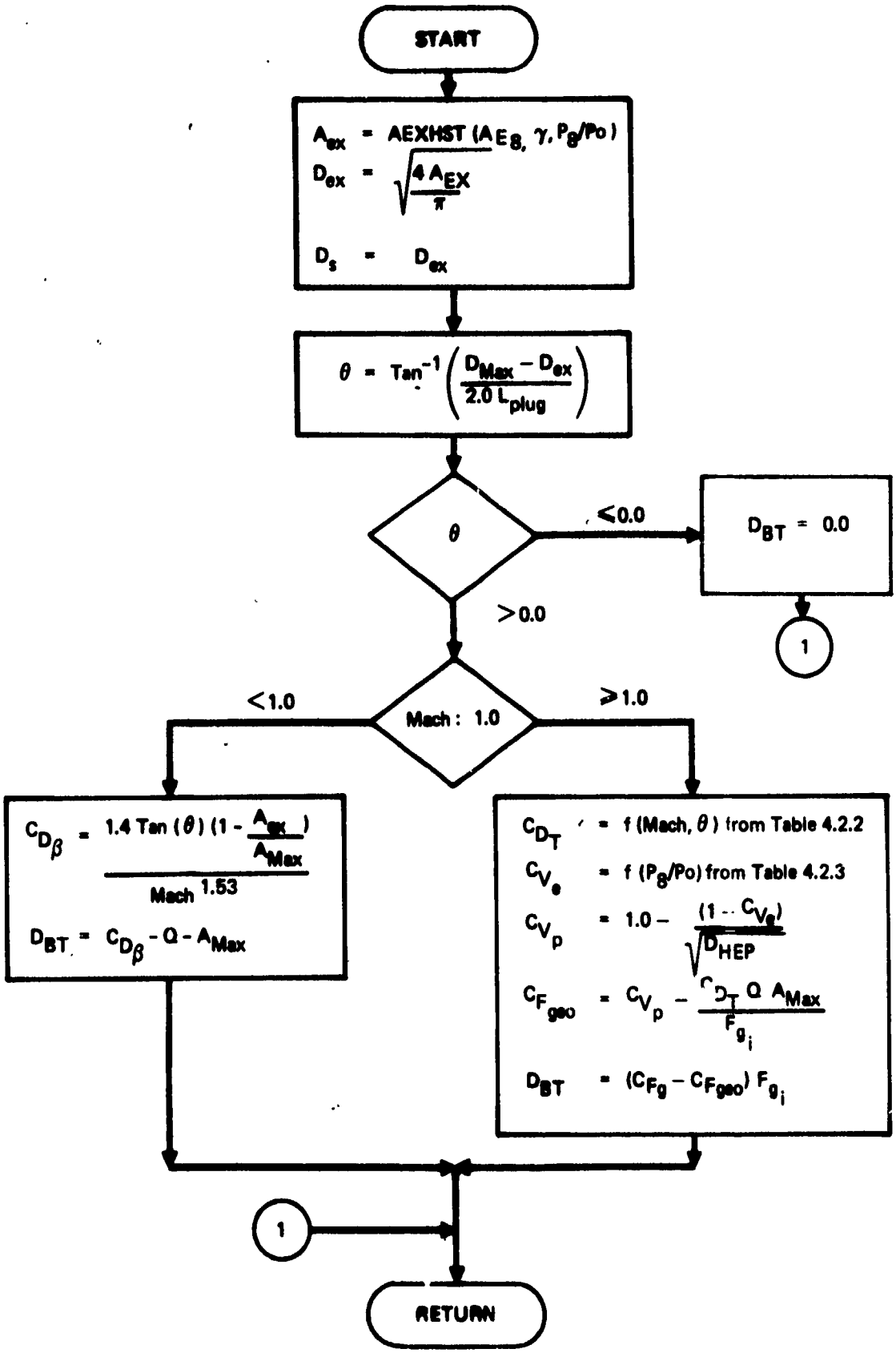


Figure 9: FLOW CHART FOR SUBROUTINE PLUGMX

```
      SUBROUTINE PLUGMX
      COMMON/AMAX/AMAX
      COMMON/DSPACE/DSPACE
      COMMON/ABINP/ AE6, A8, AE18, A18, P7QO, P17QO, FGIP, FGIF, PC,
     A              GAMMAP, GAMMAF, XM, PAMB, Q, A9, A19, CFG, DMEP,
     B              DMEF, PLUG, FLWMIX, DMAX, THICKB, ZLPLUG, ZLBTAL,
     C              S, ABASE, BTTAB, THETA
     D,             FUTURE(11), NVAR
      COMMON/ABDRAG/ DBTAIL, DNI, DBASE
      COMMON/ABTAB3/ABTX3(10),ABTY3(10),NTX3
      COMMON/ABTAB2/ABTX2(10),ABTY2(10),ABTZ2(10,10),NTX2,NTY2
      AEXJET=AEXMST(AE6,GAMMAP,P7QO)
      DEXJET=SQRT(AEXJET/.785)
      DSPACE=DEXJET
      TANTHA=.5*(DMAX-DEXJET)/ZLPLUG
      THETA=ATAN(TANTHA)*57.296
      IF (THETA.GT.0.0) GO TO 100
      DBTAIL=0.0
      GO TO 777
  100 IF (XM.GE.1.0) GO TO 200
      CDBETA=1.4*TANTHA*(1.0-AEXJET/AMAX)/(XM**1.53)
      DBTAIL=CDBETA*Q*AMAX
      GO TO 777
  200 CDT=TABJ2(XM,THETA,ABTX2,ABTY2,ABTZ2,    NTX2,NTY2,10,10)
      CVE=TABJ1(P7QO,ABTX3,ABTY3,  NTX3)
      CVP=1.0-((1.0-CVE)/SQRT(DMEP))
      CFGED=CVP-CDT*Q*AMAX/FGIP
      DBTAIL=(CFG-CFGED)*FGIP
  777 RETURN
      END
```

SUBPROGRAM LENGTH
000120

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
100 - 000024 200 - 000041 777 - 000074

EXTERNALS AND TAGS
AEXHST - S00100 SQRT - S00200 ATAN - S00300 RBAREX.- S00400
TABU2 - S00500 TABU1 - S00600 END. - S00700

BLOCK NAMES AND LENGTHS
AMAX - 000001 DSPACE - 000001 ABINP - 000051 ABDRAG - 001803
ABTAB3 - 000025 ABTAB2 - 000172

VARIABLE ASSIGNMENTS
ABTX2 - 000006C06 ABTX3 - 000000C05 ABTY2 - 000012C06 ABTY3 - 000012C05
ABTZ2 - 000024C06 AEXJET - 000110 AE8 - 000000C03 AMAX - 000001C01
COBETA - 000113 COT - 000114 CFG - 000020C03 CFGEO - 000117
CVE - 000115 CVP - 000116 DBTAIL - 000000C04 DEXJET - 000111
DHEP - 000021C03 DMAX - 000025C03 DSPACE - 000000C02 FGIP - 000006C03
FUTURE - 000035C03 GAMMAP - 000011C03 NTX2 - 000170C06 NTX3 - 000024C05
NTY2 - 000171C06 P700 - 000004C03 Q - 000015C03 TANTHA - 000112
THETA - 000034C03 XM - 000013C03 ZLPLUG - 000027C03

START OF CONSTANTS
000176

START OF TEMPORARIES
000195

START OF INDIRECTS
000110

SPACE REQUIRED TO COMPILE
03600

SUBJECT: SUBRØUTINE PLUGNM

PURPØSE: SUBRØUTINE PLUGNM computes boattail drag for a plug nozzle, non-mixed flow.

METHØD: Boattail angle is computed from the maximum diameter, the exhaust diameter and the plug length. Then Mach is checked and either the subsonic or supersonic method applied. Input tables 4.2.2 and 4.2.3 support the supersonic procedure.

Boattail drag is returned.

USAGE: CALL SUBRØUTINE PLUGNM

Input from CØMMØN/ABIN/ and CØMMØN/AMAX)
Output includes D_S for interference routine

Flags set such that: PLUG = 1.0

FLWMIX = 0.0

BTTAB = 0.0

Will cause this routine to be called

SUBPRØGRAMS: AEXHST ATAN SQRT

TABU1 TABU2

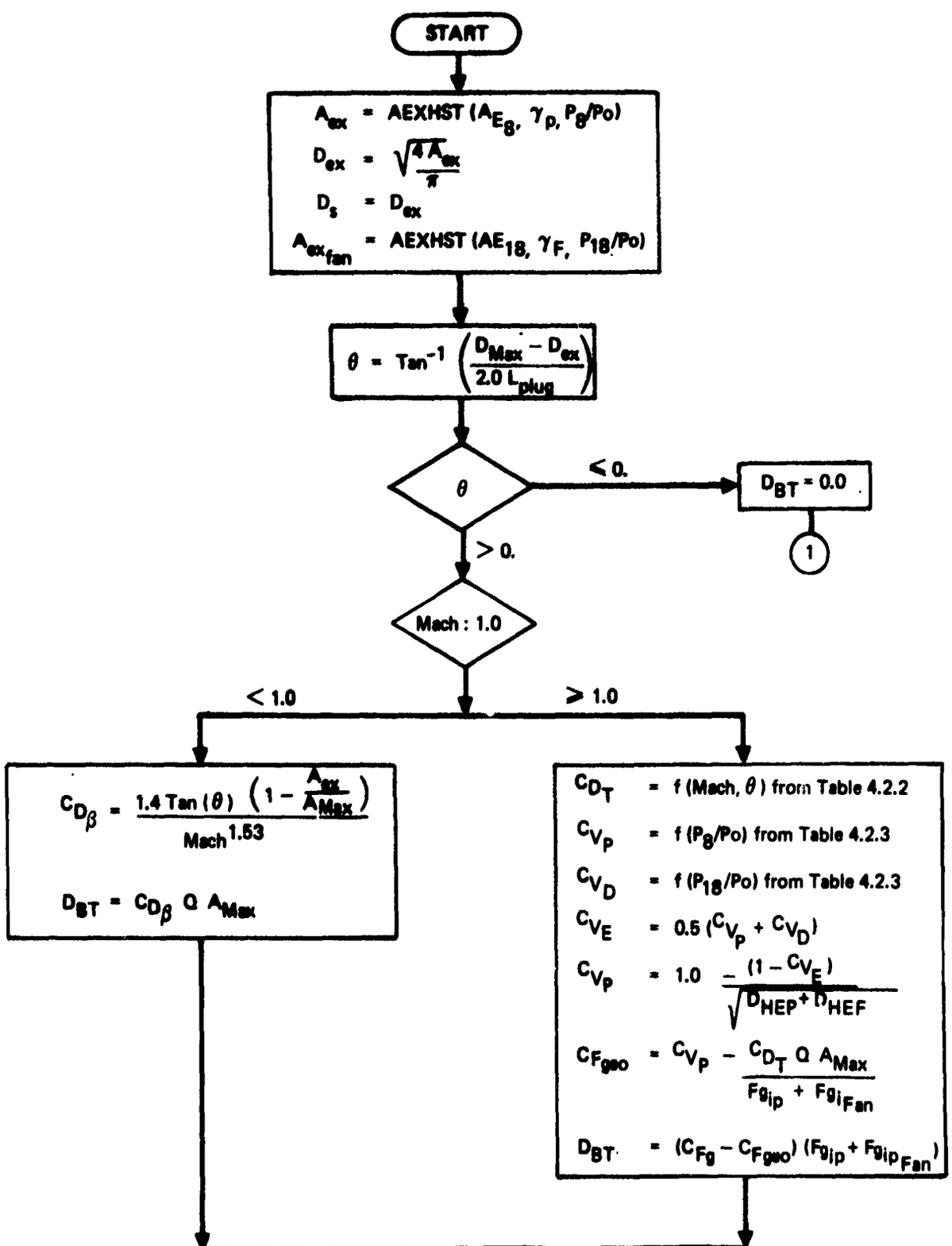


Figure 10: FLOW CHART FOR SUBROUTINE PLUGNM

```
      SUBROUTINE PLUGNM
      COMMON/ABINP/ AE8, A8, AE18, A18, P7QO, P17QO, FGIP, FGIF, PC,
     A              GAMMAP, GAMMAF, XM, PAMB, 2, A9, A19, CFG, DMEP,
     B              DMEF, PLUG, FLMMIX, DMAX, THICKB, ZLPLUG, ZLBTAL,
     C              S, ABASE, BTTAB, THETA
     D,             FUTURE(11), NVAR
      COMMON/A1AX/AMAX
      COMMON/ABJRAG/ CBTAIL, DNI, JBASE
      COMMON/DSPACE/DSPACE
      COMMON/ABTAB2/ABTX2(10),ABTY2(10),ABTZ2(10,10),NTX2,NTY2
      COMMON/ABTAB3/ABTX3(10),ABTY3(10),NTX3
      AEXFAN=AEXHST(AE18,GAMMAF,P17QO)
      AEXPRM=AEXHST(AE8,GAMMAP,P7QO)
      AEXJET=AEXPRM+AEXFAN
      DEXJET=SQRT(AEXJET/.785)
      DSPACE=DEXJET
      TANTHA=.5*(DMAX-DEXJET)/ZLPLUG
      THETA=ATAN(TANTHA)*57.296
      IF (THETA.GT.0.0) GO TO 100
      DBTAIL=0.0
      GO TO 777
  100 IF (XM.GE.1.0) GO TO 200
      CBTAIL=1.4*TANTHA*(1.0-AEXJET/AMAX)/(XM**1.53)
      JBTAIL=CBTAIL*Q*AMAX
      GO TO 777
  200 CDT=TABJ2(XM,THETA,ABTX2,ABTY2,ABTZ2,    NTX2,NTY2,10,10)
      CVP=TABJ1(P7QO,ABTX3,ABTY3,  NTX3)
      CVD=TABJ1(P17QO,ABTX3,ABTY3,  NTX3)
      CVE=.5*(CVP+CVD)
      CVP=1.0-((1.0-CVE)/SQRT(DMEP+DMEF))
      CFGE2=CVP-CDT*Q*AMAX/(FGIP+FGIF)
      DBTAIL=(CFG-CFGE2)*(FGIP+FGIF)
  777 RETURN
      END
```

SUBPROGRAM LENGTH
000145

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
100 - 000031 200 - 000046 777 - 000115

EXTERNALS AND TAGS
AEXPST - S00100 SQRT - S00200 ATAN - S00300 RBAREX.- S00400
TA3J2 - S00500 TA3U1 - S00600 END. - S00700

BLOCK NAMES AND LENGTHS
ABINP - 000351 AMAX - 000101 ABDRAG - 000003 DSPACE - 000001
ABTA32 - 000172 ABTA33 - 000025

VARIABLE ASSIGNMENTS
ABTX2 - 000000C05 ABTX3 - 000000C06 ABTY2 - 000012C05 ABTY3 - 000012C06
ABTZ2 - 000024C05 AEXFAN - 000132 AEXJET - 000134 AEXPRM - 000133
AE1B - 000022C01 AEB - 000000C01 AMAX - 000000C02 CDT - 000140
COTAIL - 000137 CFB - 000020C01 CFGE2 - 000144 CVD - 000142
CVE - 000143 CVP - 000141 DBTAIL - 000000C03 DEXJET - 000135
DMEP - 000022C01 DMEP - 000021C01 DMAX - 000025C01 DSPACE - 000000C04
FGIF - 000107C01 FGIP - 000106C01 FUTURE - 000035C01 GAMMAF - 000012C01
GAMMAP - 000110C01 NTX2 - 000017C05 NTX3 - 000024C06 NTY2 - 000171C05
P1700 - 000005C01 P700 - 000004C01 Q - 000015C01 TANTHA - 000136
THETA - 000134C01 XM - 000013C01 ZLPLUS - 000027C01

START OF CONSTANTS
000117

START OF TEMPORARIES
000126

START OF INDIRECTS
000132

SPACE REQUIRED TO COMPILE
03>/3C

SUBJECT: SUBRØUTINE ABINPT

PURPØSE: SUBRØUTINE ABINPT reads the nozzle performance data deck, cards 4.1 to 4.2.6.

METHØD: The input deck is read. The thickness of the annular base is doubled to account for top and bottom when compared to the total jet diameter. If A_{10} was input the table of $Mach_9$ vs. A_8/A_9 needed by subroutine CABTAB and the P_8/P_{AMB} lower thrust are computed. Tables not indicated by the input flags are not read.

USAGE: CALL ABINPT

All CØMMØN blocks present are defined by calling this subprogram.

SUBPRØGRAMS: TABL1 TABL2 TABL3

```
      SUBROUTINE ABINPT
      COMMON /NOZARR/ A(40)
      COMMON/ABTAB1/ AbTAB1(120),NTX1,NTY1
      COMMON/ABTAB2/ABTAB2(120),NTX2,NTY2
      COMMON/ABTAB3/ABTAB3(20),NTX3
      COMMON/ABTAB4/ABTAB4(20),NTX4
      COMMON/ABTAB5/ABTAB5(120),NTX5,NTY5
      COMMON /ABTAB6/ABTAB6(1030),NTX6,NTY6,NTZ6
      COMMON/P8PAL/P8PAL
      COMMON/AREA10/AREA10,BYA10
      COMMON /XMACH9/XMACH9(10),ABA9T(10)
      EQUIVALENCE (GAMMAP,A(10))
      DATA A /40*0.0/
      DATA XMACH9 / 2.8, 2.6, 2.4, 2.2, 2.0, 1.8, 1.6, 1.4, 1.2, 1.0 /
      READ (5,2) (A(K),K=20,29)
      READ(5,2) A(10),AREA10
      A(23)=A(23)+A(23)
      WRITE(6,3) (A(K),K=20,29),A(10),AREA10
      AREA10=AREA10*144.
      BYA10=1.0/AREA10
      WRITE(6,1)
      IF (A(25).NE.1.0) GO TO 9
      WRITE(6,5)
         CALL TABL2(ABTAB1,10,10,NTX1,NTY1)
    9 IF (A(25).EQ.0.0) GO TO 10
      CALL TABL2(ABTAB2,10,10,NTX2,NTY2)
      WRITE(6,1)
      CALL TABL1(ABTAB3,10,NTX3)
   10 IF (AREA10.LE.0.0) GO TO 15
      WRITE (6,7)
    7 FORMAT(*0ABAB TABLE*)
      CALL TABL3(ABTAB6,10,10,10,NTX6,NTY6,NTZ6)
      GP1=GAMMAP+1.0
      GM1=GAMMAP-1.0
      GP1G41=GP1/(2.0*GM1)
      DO 23 K=1,10
      ABA9T(K)=(XMACH9(K)*(.5*GP1)**GP1GM1)/((1.0+.5*GM1*XMACH9(K)**2)
     A **GP1GM1)
   23 CONTINUE
      WRITE(6,8) XMACH9,ABA9T
    8 FORMAT(*0COMPUTED TABLE - MACH9 VS A8/A9*/(1X,10F12.5))
      P8PAL=1.0/((2.0/GP1)**(GAMMAP/GM1))
      WRITE(6,11) P8PAL
   11 FORMAT(*0LOWER LIMIT OF P8/PAMB FOR P9 CALCULATION* F10.5)
   15 WRITE(6,4)
      CALL TABL1(ABTAB4,10,NTX4)
      WRITE(6,5)
      CALL TABL2(ABTAB5,10,10,NTX5,NTY5)
      RETURN
    1 FORMAT(1H1)
    2 FORMAT(10F7.0)
    3 FORMAT(*1NOZZLE INPUT DECK*/*0NOZZLE TYPE DESIGNATION* F10.1,20X,
```

```
      1*ENGINE TYPE DESIGNATION*F17.1/* MAXIMUM DIAMETER - IN*F18.1,20X,
      2*NOZZLE BASE OUTER DIAM - IN*F13.1/* OVERALL PLUG LENGTH - IN*F15.
      31,20X,*NOZZLE BOATTAIL LENGTH - IN*F13.1/* NOZZLE SPACING - IN*
      4F20.1,20X,*BASE FLOW AREA - SQ IN*F18.1/* BOATTAIL DRAG TABLE FLAG
      5*=15.1,20X,*BOATTAIL TRAILING EDGE ANGLE - DEG*F6.2/* PRIMARY  SPE
      6CIFIC HEAT RATIO*F11.2,20X,*A10 - SQ FT* F29.2 )
CC3177      4 FORMAT(*0BASE DRAG TABLE*)
CC3177      5 FORMAT(*0INTERFERENCE DRAG TABLE*)
CC3177      6 FORMAT *0BOATTAIL DRAG TABLE*)
CC3177        END
```

SUBPROGRAM LENGTH
000333

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000231	2	-	000233	3	-	000235	4	-	000312
5	-	000316	6	-	000322	7	-	000206	8	-	000213
9	-	000054	10	-	000070	11	-	000222	15	-	000157

EXTERNALS AND TAGS

INPUTC.	-	S00100	OUTPTC.	-	S00200	TABL2	-	S00300	TABL1	-	S00400
TABL3	-	S00500	RBAREX.	-	S00600	END.	-	S00700			

BLOCK NAMES AND LENGTHS

NOZARR	-	000056	ABTAB1	-	000172	ABTAB2	-	000172	ABTAB3	-	000025
ABTAB4	-	000025	ABTAB5	-	000172	ABTAB6	-	002011	PSPAL	-	000001
AREA10	-	000002	XMACH9	-	000024						

VARIABLE ASSIGNMENTS

A	-	000000C01	ABTAB1	-	000000C02	ABTAB2	-	000000C03	ABTAB3	-	000000C04
ABTAB4	-	000000C05	ABTAB5	-	000000C06	ABTAB6	-	000000C07	AREA10	-	000000C11
ABAST	-	000012012	BYA10	-	000001C11	GAMMAP	-	000011C01	GM1	-	000331
GP1	-	000330	GP1GM1	-	000332	X	-	000327	NTX1	-	000170C02
NTX2	-	000173C03	NTX3	-	000024C04	NTX4	-	000024C05	NTX5	-	000173C06
NTX6	-	002306C07	NTY1	-	000171C02	NTY2	-	000171C03	NTY5	-	000171C06
NTY6	-	002307C07	NTZ5	-	000310C07	PSPAL	-	C00000C10	XMACH9	-	000000C12

START OF CONSTANTS
000330

START OF TEMPORARIES
000325

START OF INDIRECTS
000327

SPACE REQUIRED TO COMPILE
*C36330

SUBJECT: **SUBRØUTINE SUBBT**

PURPØSE: **SUBRØUTINE SUBBT** computes boattail drag for a convergent-divergent nozzle when Mach < .9.

METHØD: The quantity $D_J^2/(D_B \cdot D_M)$ is tested. If it is greater than 0.25 boattail drag is determined directly from built in tables XI and XII. If not, an emperical method to develop base and boattail drag is used.

USAGE: CALL SUBBT (DMDJ, DBDJ, EMF, PTPF, THETA, ICØN, GAM)

DMDJ	Ratio of maximum to jet diameter
DBDJ	Ratio of base to jet diameter
EMF	Free-stream Mach number
PTPF	Ratio of jet total to free-stream static pressure
THETA	Boattail trailing edge angle - degrees
GAM	Ratio of specific heats
ICØN	= 0 circular arc boattail = 1 conical boattail

SUBPRØGRAMS: CABTAB TABU1 TABU2

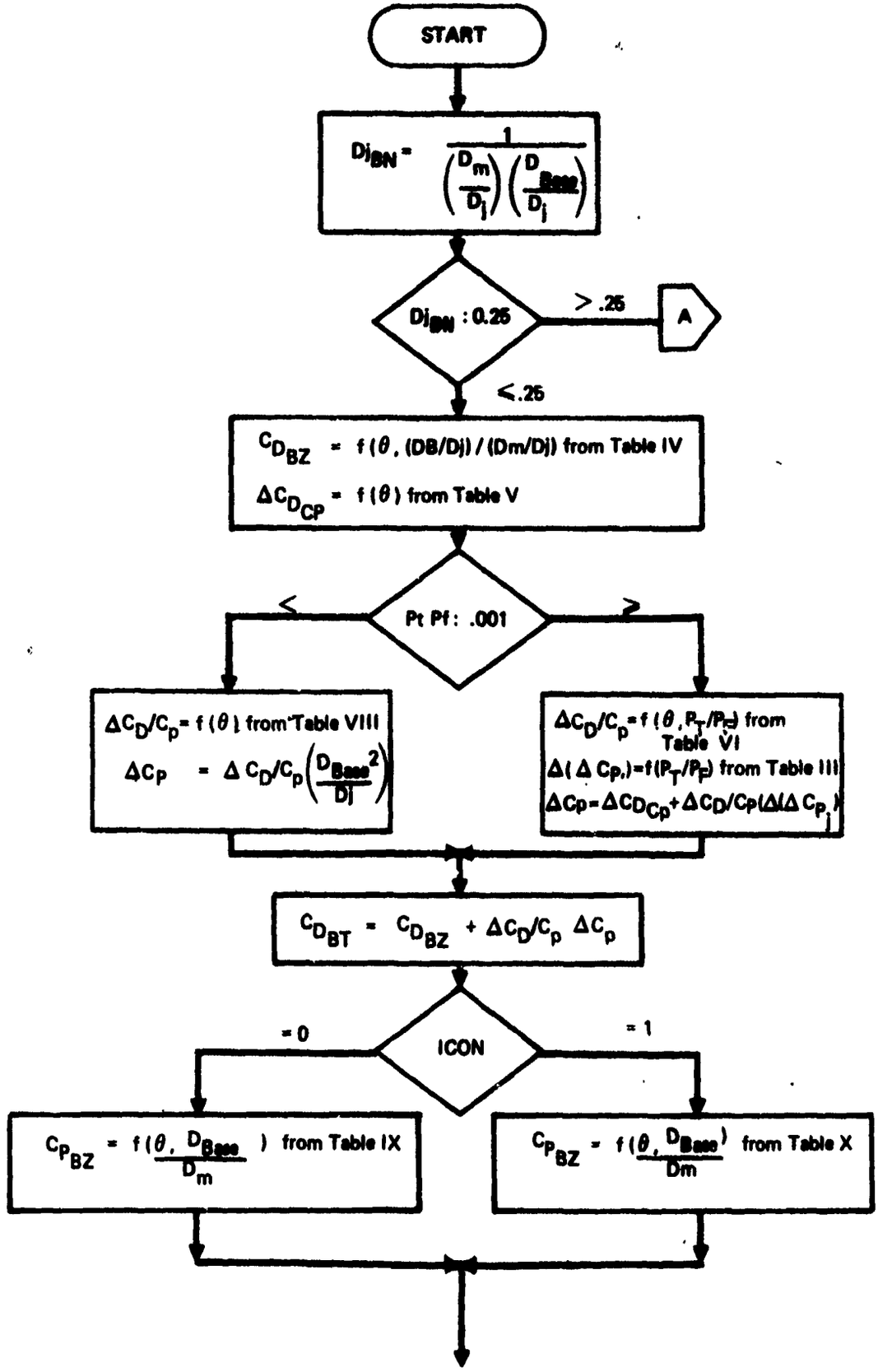


Figure 11: FLOW CHART FOR SUBROUTINE SUBBT

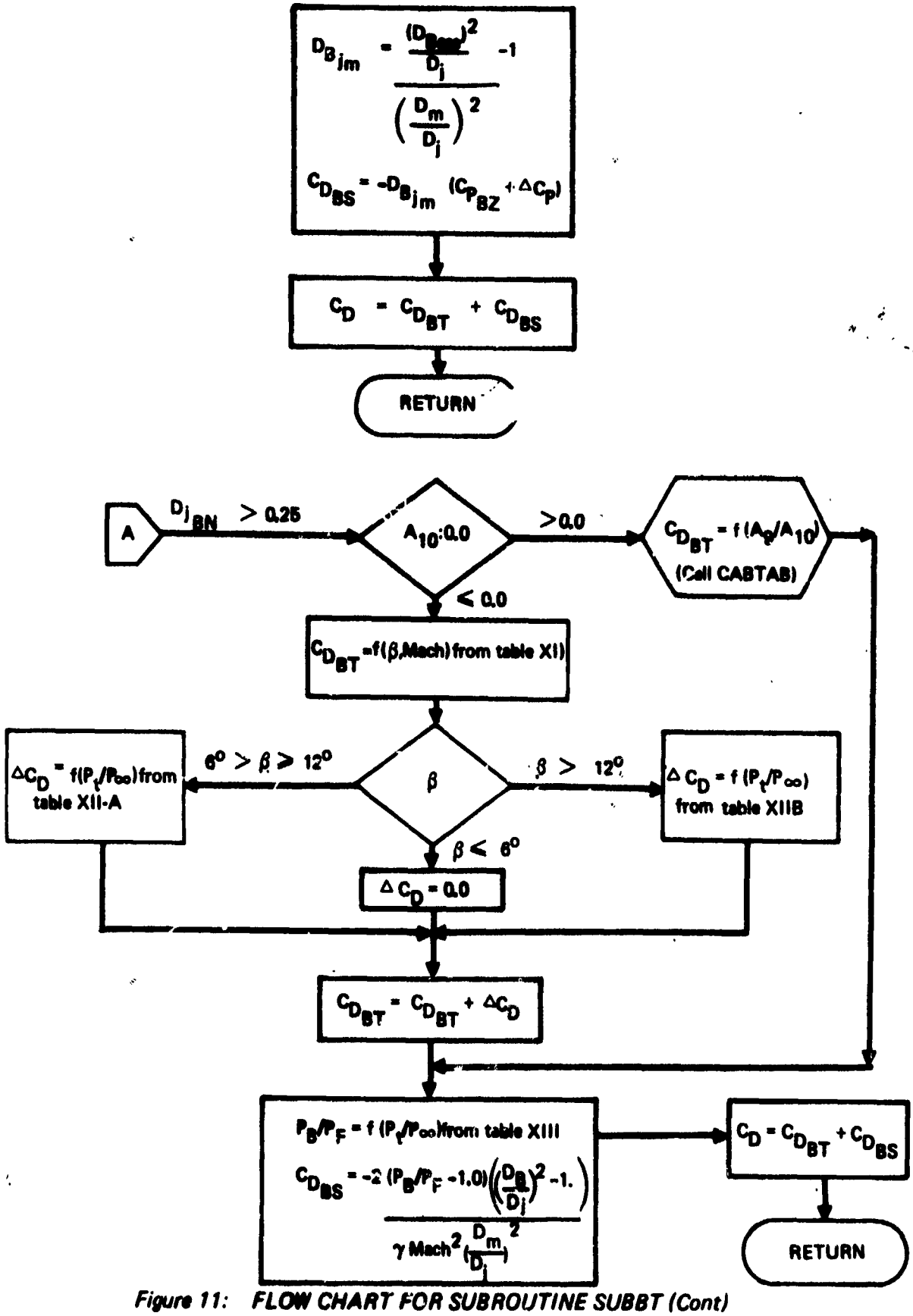


Figure 11: FLOW CHART FOR SUBROUTINE SUBBT (Cont)

```
      SUBROUTINE SUBBT(DMDJ,DBDJ,EMF,PTPF,THETA,ICON,GAM)

0000 12       COMMON/AREA10/AREA10,BYA10
0000 12       COMMON/A/CO,CDBS,CDBT,BETAO

0000 12       COMMON/DRGTB/NT1,TB1(3),TBF1(3),NT2,TB2(20),TBF2(20),NT3,TB3(10),
     1              TBF3(10),NTX4,NTY4,TBX4(5),TBY4(11),TBF4(5,11),NT5,
     2              TB5(6),TBF5(6),NTX6,NTY6,TBX6(5),TBY6(7),TBF6(5,7),
     3              NT7,TB7(7),TBF7(7),NT8,TB8(5),TBF8(5),NTX9,NTY9,
     4              TBX9(5),TBY9(9),TBF9(5,9),NTX10,NTY10,TBX10(5),
     5              TBY10(7),TBF10(5,7),NTX11,NTY11,TBX11(5),TBY11(6),
     6              TBF11(5,6),NT12A,TB12A(10),TBF12A(10),NT12B,TB12B(10)
     7             ,TBF12B(10),NT13,TB13(10),TBF13(10)

0000 12       REAL LDJ.

0000 12       DJBM=1./(DMDJ*DBDJ)
0001 14       IF(DJBM .GT. .25)GO TO 500
0001 17       DBJM=DBDJ/DMDJ
0002 20       CDBZ=TABJ2(THETA,DBJM,TBX4,TBY4,TBF4,NTX4,NTY4,5,11)
0003 34       DCDCP=TABU1(THETA,TB5,TBF5,NT5)
0003 43       IF(PTPF .GE. .01)GO TO 100
0004 46       DCPDJ=TABU1(THETA,TB8,TBF8,NT8)
0005 55       DCP=DCPDJ/DBDJ**2
0005 57       GO TO 200

0006 60   100 CONTINUE
0006 60       DCDCP=TABJ2(THETA,PTPF,TBX6,TBY6,TBF6,NTX6,NTY6,5,7)
0006 74       DDCPJ=TABU1(PTPF,TB7,TBF7,NT7)
0007 03       DCP=DCPJ+DDCPJ*DJBM
0007 06   200 CONTINUE
0007 06       CDBT=CDBZ+DCDCP*DCP

0007 11       IF(ICON .EQ. 1)GO TO 300
0007 13       CPBZ=TABJ2(THETA,DBJM,TBX9,TBY9,TBF9,NTX9,NTY9,5,9)
0007 27       GO TO 400

0007 30   300 CONTINUE

      C          *NOTE* TABLE 10 - MAXIMUM THETA = 8 DEGREES

0007 30       CPBZ=TABJ2(THETA,DBJM,TBX10,TBY10,TBF10,NTX10,NTY10,5,7)
0007 45   400 CONTINUE
0007 45       DBJM=(DBDJ*DBDJ-1.)/(DMDJ*DMDJ)
0007 50       CDBS=-DBJM*(CPBZ+DCP)
0007 53       CD=CDBS+CDBT
0007 55       GO TO 600

0007 56   500 CONTINUE
0007 56       IF(AREA10.GT.0.0) GO TO 700
0007 61       CD=TABU2(BETAO,EMF,TBX11,TBY11,TBF11,NTX11,NTY11,5,6)
0007 75       DCD=0.0
```

```
000176          IF (BETAJ.LE.6.0) GO TO 550
000201          IF (BETAJ.GT.12.0) GO TO 525
000204          DCJ=TABJ1(PTPF,TB12A,TBF12A,NT12A)
000212          GO TO 553
000213      700 CALL CABTAB(CDBT,EMF)
000215          GO TO 575
000221      525 DCJ=TABJ1(PTPF,TB128,TBF128,NT128)
000236      553 CJBT=CO+DCJ

000232      575 CONTINUE
000232          PBPF=TABJ1(PTPF,T313,TBF13,NT13)
000241          CDBS=-2.*(PBPF-1.)*(DBDJ*DBDJ-1.)/(GAM*EMF*EMF*DMDJ*DMDJ)

000253          CJ=CJBT+DJBS

000255      600 CONTINUE
000255          RETURN
000256          END
```

SUBPROGRAM LENGTH
000313

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

100	-	000060	200	-	000106	300	-	000130	400	-	000145
500	-	000156	525	-	000221	550	-	000230	575	-	000232
600	-	000255	700	-	000213						

EXTERNALS AND TAGS

TABU2	-	S00100	TABU1	-	S00200	CABTAB	-	S00300	END.	-	S00400

BLOCK NAMES AND LENGTHS

AREA1C	-	000002	A	-	000004	DRGTB	-	000676			

VARIABLE ASSIGNMENTS

AREA1C	-	000000C01	BETAD	-	00000C02	CD	-	000000C02	CDBS	-	000001C02
CDBT	-	000002C02	CDBZ	-	000301	CPBZ	-	000307	DBDM	-	000300
DBJM	-	000310	DCJ	-	000311	DCJDCP	-	000302	DCP	-	000304
DCPJ	-	000306	DCPJJ	-	000303	DDCPJ	-	000305	DJBM	-	000277
GAM	-	000000	LOJ	-	000276	NTX10	-	000443C03	NTX11	-	000524C03
NTX4	-	000102C03	NTX5	-	000233C03	NTX9	-	000340C03	NTY10	-	000444C03
NTY11	-	000525C03	NTY4	-	000106C03	NTY5	-	000234C03	NTY9	-	000347C03
NT12A	-	000577C03	NT12B	-	000624C03	NT13	-	000651C03	NT5	-	000216C03
NT7	-	000314C03	NT8	-	000353C03	PBPF	-	000312	TBF1	-	000004C03
TBF10	-	000461C03	TBF11	-	000541C03	TBF12A	-	000612C03	TBF12B	-	000637C03
TBF13	-	000564C03	TBF2	-	000034C03	TBF3	-	000073C03	TBF4	-	000127C03
TBF5	-	000225C03	TBF6	-	000251C03	TBF7	-	000324C03	TBF8	-	000341C03
TBF9	-	000360C03	TBX10	-	000445C03	TBX11	-	000526C03	TBX4	-	000107C03
TBX5	-	000235C03	TBX9	-	000350C03	TBY10	-	000452C03	TBY11	-	000533C03
TBY4	-	000114C03	TBY5	-	000242C03	TBY9	-	000355C03	TB1	-	000001C03
TB12A	-	000600C03	TB12B	-	000625C03	TB13	-	000652C03	TB2	-	000010C03
TB3	-	000061C03	TB5	-	000217C03	TB7	-	000315C03	TB8	-	000334C03

START OF CONSTANTS
000257

START OF TEMPORARIES
000272

START OF INDIRECTS
000276

SPACE REQUIRED TO COMPILE
037000

SUBJECT: SUBRØUTINE SUPBT

PURPØSE: SUBRØUTINE SUPBT computes boattail and base drag for a convergent-divergent nozzle when Mach > 1.0.

METHØD: Boattail drag is computed using Table I, then if a base has been defined base drag is computed and added to compute a total drag.

USAGE: CALL SUPBT (DMDJ, DBDJ, EMF, EMJD, PTPF, GAM, TANB)

DMDJ	Ratio of maximum of jet diameter
DBDJ	Ratio of base to jet diameter
EMF	Free-stream Mach number
EMJD	Jet design Mach number
PTPF	Ratio of jet total to free-stream static pressure
GAM	Ratio of specific heats
TANB	Tangent of boattail chord angle

SUBPRØGRAM:

ALØG	CABTAB	EXP
SQRT	TABUl	

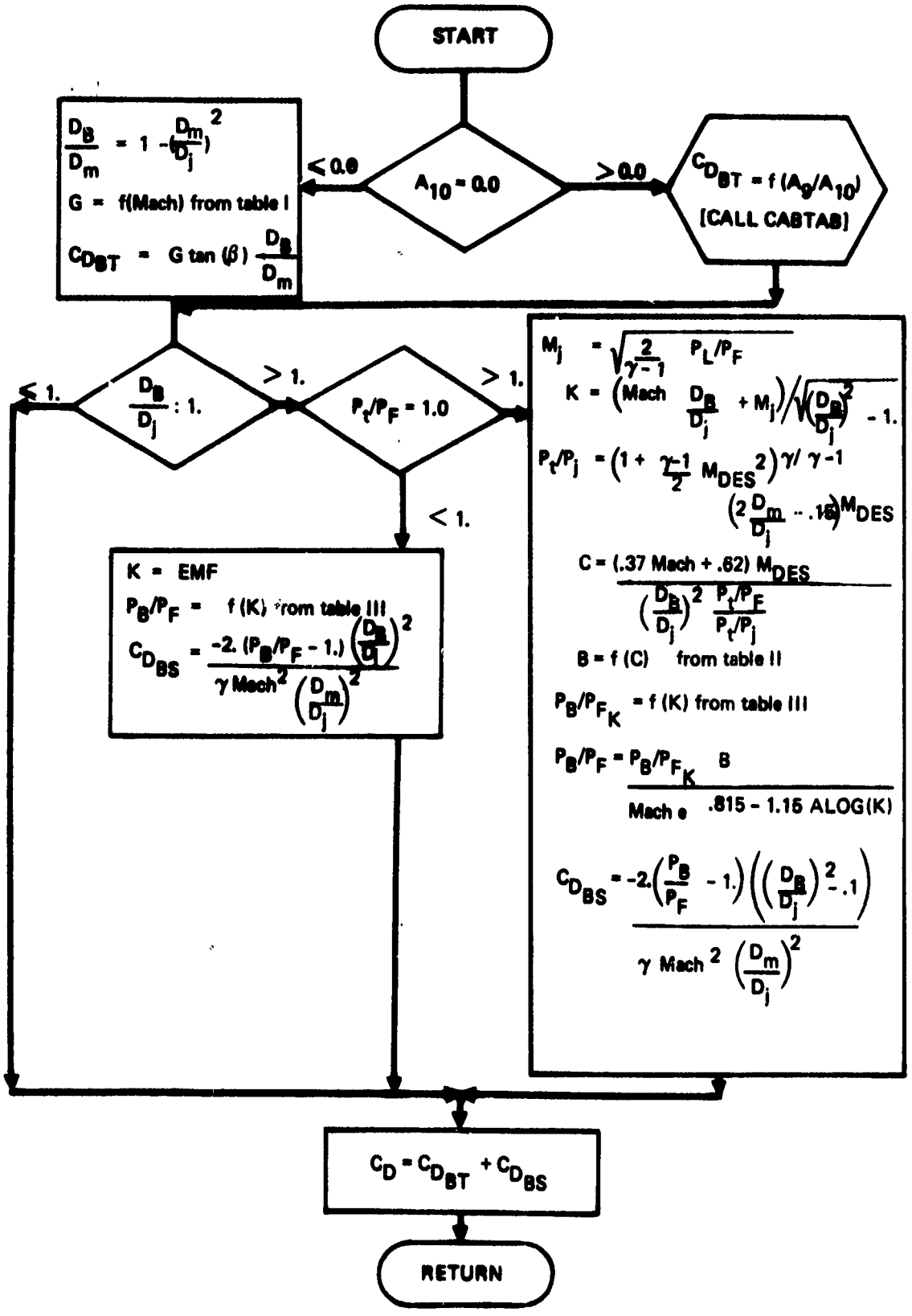


Figure 12: FLOW CHART FOR SUBROUTINE SUPBT

```
      SUBROUTINE SUPBT(DMOJ,DBOJ,EMF,EMJO,PTPF,GAM,TANB)
C000 12      COMMON/A/CD,CDBS,CDBT,BETAO
C000 12      COMMON/AREA10/AREA10,BYA10

C000 12      COMMON/DRGTB/NT1,TB1(3),TBF1(3),NT2,TB2(20),TBF2(20),NT3,TB3(10),
     1              TBF3(10),NTX4,NTY4,TBX4(5),TBY4(11),TBF4(5,11),NT5,
     2              TB5(5),TBF5(6),NTX6,NTY6,TBX6(5),TBY6(7),TBF6(5,7),
     3              NT7,TB7(7),TBF7(7),NT8,TB8(5),TBF8(5),NTX9,NTY9,
     4              TBX9(5),TBY9(9),TBF9(5,9),NTX10,NTY10,TBX10(5),
     5              TBY10(7),TBF10(5,7),NTX11,NTY11,TBX11(5),TBY11(6),
     6              TBF11(5,6),NT12A,TB12A(10),TBF12A(10),NT12B,TB12B(10)
     7             ,TBF12B(10),NT13,TB13(10),TBF13(10)

C000 12      REAL LOJ,K

C000 12      IF (AREA10.LE.0.0) GO TO 50
C000 13      CALL CABTAB(CDBT,EMF)
C000 15      GO TO 100
C000 21   50 CONTINUE
C000 21      GM1=GAM-1.
C000 23      DBOMF=1.-(DBOJ/DMOJ)**2
C000 26      G=TABU1(EMF,TB1,TBF1,NT1)
C000 36      CDBT=G*TANB*DBOMF

C000 40  100 CONTINUE

C000 40      IF(DBOJ .LE. 1.)GO TO 300
C000 43      DMOJ2=DMOJ*DMOJ
C000 44      DBOJ2=DBOJ*DBOJ

C000 45      IF(PTPF .GT. 1.)GO TO 200
C000 50      K=EMF
C000 51      PBPF=TABU1(K,TB3,TBF3,NT3)
C000 55      CDBS=-2.*(PBPF-1.)*DBOJ2/(GAM*EMF*EMF*DMOJ2)
C000 67      GO TO 300

C000 70  200 CONTINUE
C000 70      EMJ=SQRT(2./GM1*(PTPF**(GM1/GAM)-1.))
C001 05      K=(EMF*EMJO+EMJ)/SQRT(DBOJ2-1.)
C001 20      PTPJ=(1.+.5*GM1*EMJO*EMJO)**(GAM/GM1)
C001 30      B=(.37*EMF+.62)*EMJO**((.2*DBOJ-.15)*EMJO)/DBOJ2*PTPF/PTPJ
C001 45      B=TABU1(B, TB2,TBF2,NT2)
C001 51      PBPFK=TABU1(K,TB3,TBF3,NT3)
C001 55      PBPF=PBPFK*B/(EMF* EXP(.815-1.15*ALOG(K)))
C002 01      CDBS=-2.*(PBPF-1.)*(DBOJ2-1.)/(GAM*EMF*EMF*DMOJ*DMOJ)

C002 11  300 CONTINUE
C002 11      CD=CDBT+CDBS

C002 13      RETURN
C002 14      END
```

SUBPROGRAM LENGTH
000200

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
50 - 000021 100 - 000040 200 - 000070 300 - 000211

EXTERNALS AND TAGS
CASTAB - SC0100 TABJ1 - S00200 SQRT - S00300 RBAREX.- S00400
EXP - SC0500 ALOG - SC0600 END. - SC0700

BLOCK NAMES AND LENGTHS
A - 000004 AREA10 - 000002 ORGTB - 000676

VARIABLE ASSIGNMENTS
AREA1C - 000000C02 B - 000256 C - 000255 CD - 000000C01
CD0S - 000001C01 CD3F - 000002C01 DBOJ2 - 000251 DBDMF - 000246
DMDJ2 - 000250 EMJ - 000253 G - 000247 GM1 - 000245
K - 000244 LOJ - 000243 MT1 - 000000C03 MT2 - 000007C03
MT3 - 000000C03 PBPF - 000252 PBPFK - 000257 PTPJ - 000254
TAB - 000000 TBF1 - 000004C03 TBF1C - 000461C03 TBF11 - 000541C03
TBF12A - 000612C03 TBF12B - 000637C03 TBF13 - 000664C03 TBF2 - 000034C03
TBF3 - 000073C03 TBF4 - 000127C03 TBF5 - 000225C03 TBF6 - 000251C03
TBF7 - 000324C03 TBF9 - 000341C03 TBF9 - 000366C03 TBX10 - 000445C03
TBX11 - 000520C03 TBX4 - 000167C03 TBX6 - 000235C03 TBX9 - 000350C03
TBY13 - 000452C03 TBY11 - 000533C03 TBY4 - 000114C03 TBY6 - 000242C03
TBY9 - 000359C03 TB1 - 000001C03 TB12A - 000600C03 TB12B - 000625C03
TB13 - 000452C03 TB4 - 000010C03 TB3 - 000051C03 TB5 - 000217C03
TB7 - 000315C03 TB9 - 000334C03

START OF CONSTANTS
000215

START OF TEMPORARIES
000227

START OF INDIRECTS
000243

SPACE REQUIRED TO COMPILE
036500

SUBJECT: SUBRØUTINE DRAGAB

PURPØSE: SUBRØUTINE DRABAG monitors the afterbody drag calculation.

METHØD: The input array is transferred to the afterbody CØMMØN block ABINP. A check is made on Mach number. If Mach is equal to zero drag is set equal to zero and no further afterbody calculations performed. If Mach is greater than zero, boattail drag, nozzle interference, and base drag routines are called to compute the various drags. The total airplane drag is returned for nozzle interference and base drag so these are converted to one engine values. The output array is loaded with the various C_D's based upon area AMAX (drag may have been computed using a different area).

USAGE: CALL DRAGAB (ABIN, ABØUT)

ABIN (40) - Input array

ABØUT (10) - Output array

The input array is defined as follows:

ABIN

1	AE8	Primary nozzle effective area - in^2
2	A8	Primary nozzle geometric thrust area - in^2
3	AE18	Fan nozzle effective area - in^2
4	A18	Fan nozzle geometric thrust area - in^2
5	P_8/P_0	Primary nozzle pressure ratio
6	P_{18}/P_0	Fan nozzle pressure ratio
7	FGIP	Primary nozzle ideal thrust (actual mass flow) lb
8	FGIF	Fan nozzle ideal thrust (actual mass flow) lb
9	PC	Power setting
10	GAMMAP	Primary flow specific heat ratio

ABIN (continued)

11	GAMMAF	Fan flow specific heat ratio
12	XM	Free-stream Mach number
13	PAMB	Ambient static pressure psia
14	Q	Free-stream dynamic pressure psia
15	A9	Primary nozzle exit area in^2
16	A19	Fan nozzle exit area in^2
17	CFG	Nozzle internal performance coefficient
18	DHEP	
19	DHEF	
20	PLUG	Nozzle type designation
21	FLWMIX	Mixed flow flag
22	DMAX	Maximum diameter, in.
23	THICKB	Total thickness of annular base, in.
24	ZLPLUG	Overall plug length, in.
25	ZLBTAL	Nozzle boattail length, in.
26	S	Nozzle centerline spacing, in.
27	ABASE	Base flow area, in^2.
28	BTTAB	Boattail table flag
29	THETA	
30	XDNI	Number of nozzle interference spacings
32-40		Not defined

SUBPRØGRAMS: DBASER DBØATR DINTFR

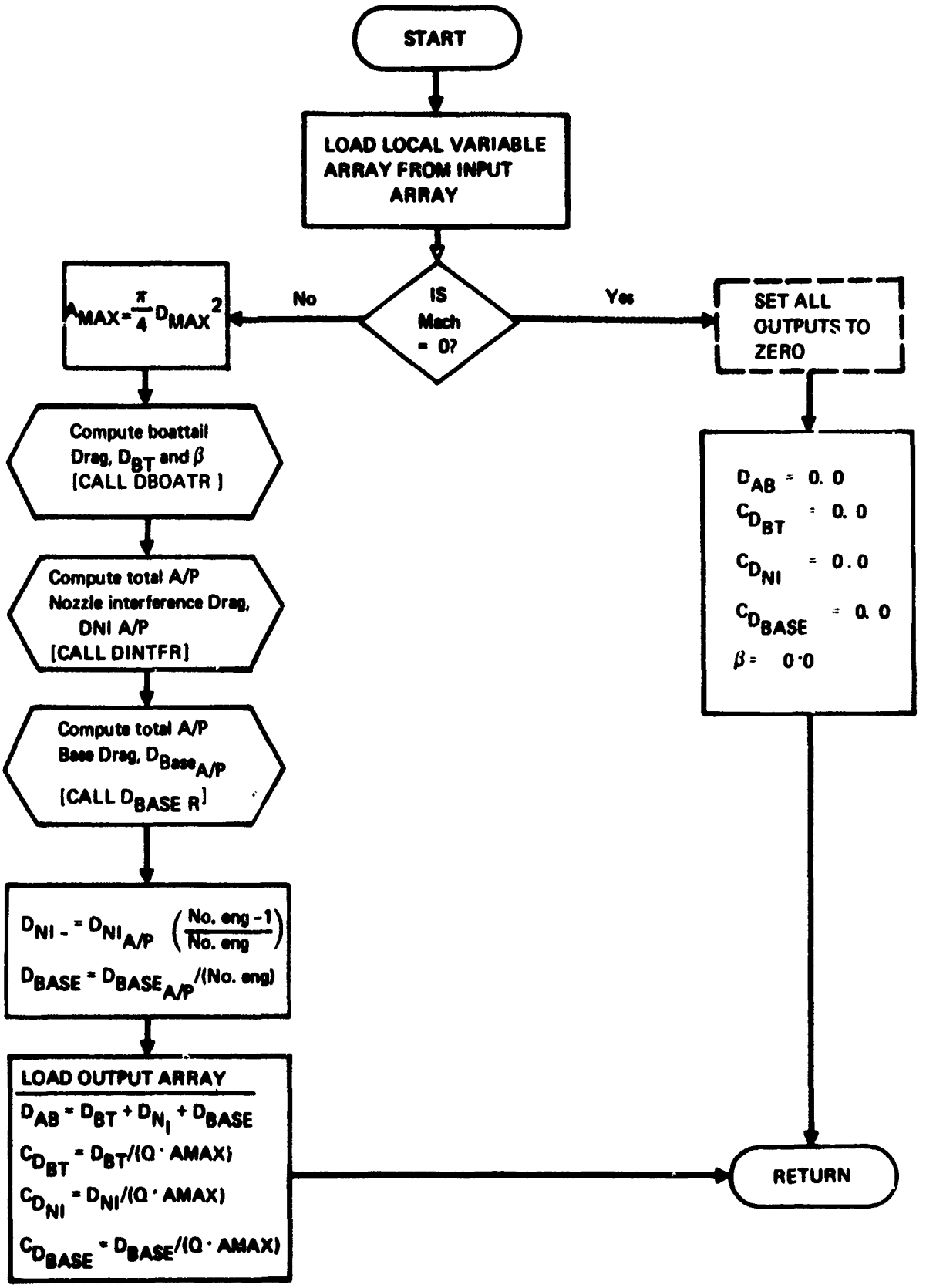


Figure 13: FLOW CHART FOR SUBROUTINE DRAGAB

```
      SUBROUTINE DRAGAB(ABIN,ABOUT)
      DIMENSION ABIN(40),ABOUT(10)
      COMMON/ABINP/ABINP(40),NVAR
      COMMON/ABDRAG/ DBTAIL, DNI, DBASE
      COMMON/A/AAA(3),BETAD
      COMMON/AMAX/AMAX
      EQUIVALENCE (ABINP(12),XM), (ABINP(14),Q), (ABINP(30),XDNI),
     A            (ABINP(31),XDBASE), (ABINP(72),DMAX)
      DATA NVAR/31/
      DATA PIBY4/.7854/
C RETRIEVE INPUTS FROM ENGINE PROGRAM
C        AE8    =  ABIN(1)
C        A8     =  ABIN(2)
C        AE18   =  ABIN(3)
C        A18    =  ABIN(4)
C        P7D    =  ABIN(5)
C        P17D   =  ABIN(6)
C        FGIP   =  ABIN(7)
C        FGIF   =  ABIN(8)
C        PC     =  ABIN(9)
C        GAMMAP=   ABIN(10)
C        GAMMAF=   ABIN(11)
C        XM     =  ABIN(12)
C        PAMB   =  ABIN(13)
C        Q      =  ABIN(14)
C        A9     =  ABIN(15)
C        A19    =  ABIN(16)
C        CFG    =  ABIN(17)
C        DMEP   =  ABIN(18)
C        DMEF   =  ABIN(19)
C        PLUG   =  ABIN(20)   NOZZLE TYPE DESIGNATION
C        FLMMIX=   ABIN(21)   ENGINE TYPE DESIGNATION
C        DMAX   =  ABIN(22)
C        DMBASE=   ABIN(23)
C        ZLPLUG=   ABIN(24)
C        ZLBTAL=    ABIN(25)
C        S      =  ABIN(26)
C        ABASE  =  ABIN(27.
C        BTTAB  =  ABIN(28)   BOATTAIL TABLE INDICATOR
      DO 10 I=1,NVAR
   10 ABINP(I)=ABIN(I)
      IF (AMACH.EQ.0.0) GO TO 15
      AMAX=PIBY4*DMAX**2
      QAMAX=1.0/(Q*AMAX)
C CALL SUBPROGRAMS TO COMPUTE VARIOUS DRAGS
      CALL DBOATR
      CALL DINTFR
      CALL DBASER
C     CALL USERDR
      GO TO 20
   15 DO 16 J=1,5
```

```
0000 30        18 ABOUT(J)=0.0
0000 33           RETURN
          C STORE OUTPUT TO ENGINE PROGRAM
0000 34        20 CONTINUE
0000 34           DNI=DNI*XDNI
0000 36           DBASE=DBASE*XDBASE
0000 37           ABOUT(1)=DBTAIL*DNI*DBASE
0000 42           ABOUT(2)=DBTAIL*QAMAX
0000 43           ABOUT(3)=DBASE*QAMAX
0000 44           ABOUT(4)=DNI*QAMAX
0000 45           ABOUT(5)=BETAO
0000 47           RETURN
0000 47           END
```

SUBPROGRAM LENGTH
000C56

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
15 - 000020 18 - 000030 20 - 000034

EXTERNALS AND TAGS
OBJATR - S00100 DINTER - S00200 OBASER - S00300 END. - S00400

BLOCK NAMES AND LENGTHS
ABINP - 000051 ABDRAG - 000003 A - 000004 AMAX - 000001

VARIABLE ASSIGNMENTS
AXR - 00C000C03 ABINP - 000000C01 AMAX - 000000C04 BETAD - 000003C03
OBASE - 000002C02 OBTAIL - 000000C02 OMAX - 000025C01 ONI - 00000 1C02
I - 000053 J - 000055 NVAR - 00005CC01 PIBY4 - 000052
Q - 000013C01 QAMAX - 000054 XOBASE - 000035C01 XONI - 000035C01
XM - 000013C01

START OF CONSTANTS
000050

START OF TEMPORARIES
000051

START OF INDIRECTS
000052

SPACE REQUIRED TO COMPILE
035400

SUBJECT: SUBRØUTINE DBØATR

PURPØSE: SUBRØUTINE DBØATR monitors the calculation of boattail drag.

METHØD: The input flags PLUG, FLWMIX, and BTTAB are interrogated to determine which boattail method is desired and the appropriate routine selected.

USAGE: CAL DBØATR

Input through CØMMØN/ABIN/

SUBPRØGRAMS: CDCØNV DBTTB PLUGMIX PLUGNM

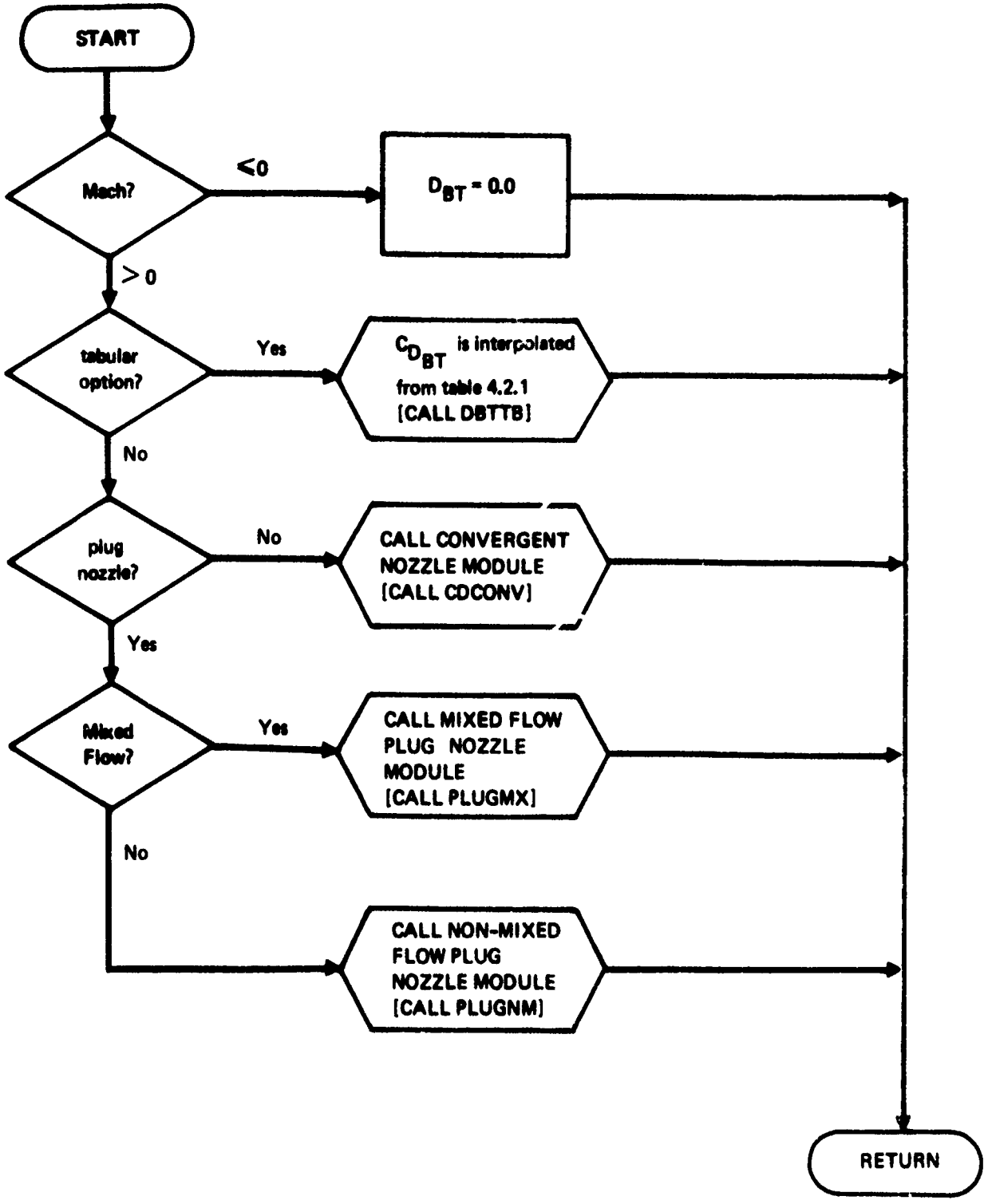


Figure 14: FLOW CHART FOR SUBROUTINE DBOATR

```
                      SUBROUTINE DBOATR
0000 02               COMMON/ABINPT/ AE8, A8, AE18, A18, P7QQ, P17QQ, FGIP, FGIF, PC,
                     A               GAMMAP, GAMMAF, XM, PAMB, Q, A9, A19, CFG, DMEP,
                     B               DMEF, PLUG, FLWMIX, DMAX, THICKB, ZLPLUG, ZLBTAL,
                     C               S, ABASE, BTTA3, THETA
                     D,              FUTURE(11), NVAR
0000 02               COMMON/ABDRAG/ DBTAIL, DNI, DBASE
                C     SELECT PROPER OPTION
0000 02               DBTAIL=0.0
0000 03               IF (XM.EQ.0.0) RETURN
0000 05               IF (BTTA3.EQ.1.0) GO TO 300
0000 07               IF (PLUG.EQ.0.0)  GO TO 200
0000 10               IF (FLWMIX.EQ.1.0) GO TO 100
                C NON-MIXED ENGINE FLOW - PLUG NOZZLE
0000 12               CALL PLUGNM
0000 13               GO TO 400
                C MIXED ENGINE FLOW - PLUG NOZZLE
0000 14            100 CALL PLUGMX
0000 15               GO TO 400
                C C-D OR CONVERGENT NOZZLE
0000 16            200 CALL CDCONV
0000 17               GO TO 400
                C TABULAR INPUT
0000 20            300 CALL DBTT3
0000 21            400 RETURN
0000 22               END
```

SUBPROGRAM LENGTH
000024

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
100 - 000014 200 - 000016 300 - 000020 400 - 000021

EXTERNALS AND TAGS
PLJGNM - SC0100 PLJGMX - SJ0200 CDCJNV - SC0300 OBTTB - SC0400
END. - SC0500

BLOCK NAMES AND LENGTHS
ABINP - 000051 ABDRAG - 000003

VARIABLE ASSIGNMENTS
ETTAB - 000035C01 OBTAIL - 000000C02 FLW4IX - C00024C01 FUTURE - C00035C01
PLJG - 000023C01 XM - 000013C01

START OF CONSTANTS
000023

START OF TEMPORARIES
000024

START OF INDIRECTS
000024

SPACE REQUIRED TO COMPILE
0352D0

SUBJECT: SUBRØUTINE CABTAB

PURPØSE: SUBRØUTINE CABTAB computes afterbody drag as a function of A_9/A_{10}, P_9/P_{AMB}, and Mach.

METHØD: The drag coefficient is input in tabular form in input Table 4.2.4. Mach and A_8/A_{10} are known; the suprogram computes P_9/P_{AMB} after interpolating $Mach_9 = f(A_8/A_9)$ from a table generated by the program. The table generated in the input routine ABINP is developed as follows:

For $Mach_9$ = 2.8, 2.6, 2.4 ..., 1.0 compute

$$A_8/A_9 = \left(\frac{\gamma+1}{2}\right)^{\frac{\gamma+1}{2(\gamma-1)}} Mach_9 \left(1+\frac{\gamma-1}{2} Mach_9^2\right)^{\frac{-\gamma+1}{2(\gamma-1)}}$$

The resulting array of A_8/A_9 is strictly increasing; hence serves as an independent variable array with $Mach_9$ as the dependent array. The subroutine also checks P_8/P_0 against 1 lower bound value of $P_8/P_{0_{LB}}$ = 1/(

The $C_{D_{AB}}$ obtained from Table 4.2.4 is based on an area A_{10} whereas the program uses A_{MAX} (most of the time these two inputs will have the same value), consequently the C_D is ratioed by A_{10}/A_{MAX} before returning to the calling program.

USAGE: CALL CABTAB (CAB, AM)

Output CAB - Afterbody drag coefficient

AM Free-stream Mach number

Input from CØMMØN/ABINP/,/AMAX/,/AREA10/,/P8PAL/, /XMACH9/, and /ABTAB6/

SUBPRØGRAMS: TABU1 TABU3

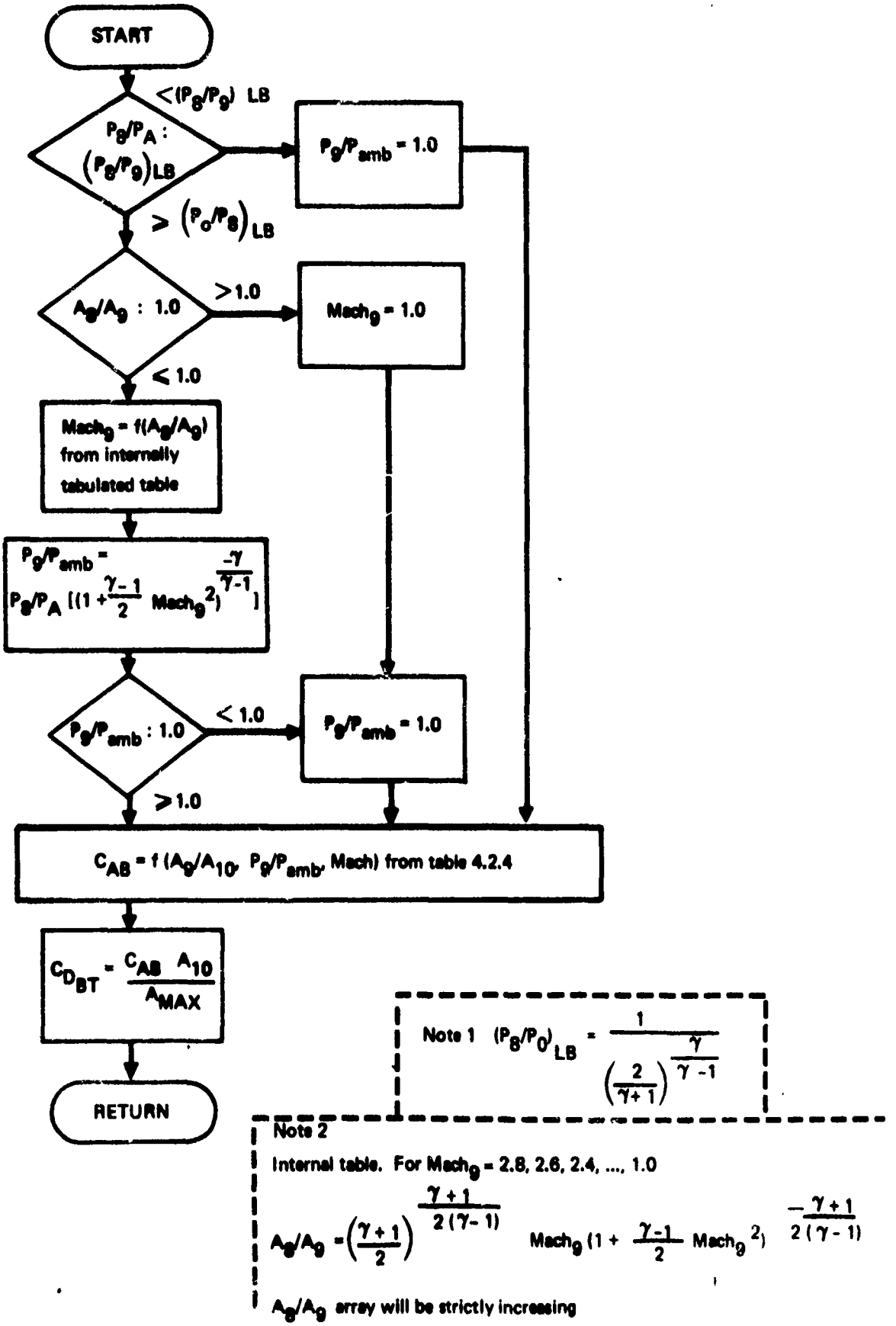


Figure 15: FLOW CHART FOR SUBROUTINE CABTAB

```
      SUBROUTINE CABTAB(CAB,AM)
      COMMON /XMACH9/XMACH9(10),A8A9T(10)
      COMMON/AREA10/AREA10,BTA10
      COMMON/AMAX/AMAX
      COMMON/ABINP/ AE8, A8, AE10, A10, P7Q0, P97Q0, FGIP, FGIF, PC,
     A              GAMMAP, GAMMAF, XM, PAM8, Q, A9, A19, CFG, DMEP,
     B              DMEF, PLUG, FLAMIX, DMAX, THICK8, ZLPLUG, ZLBTAL,
     C              S, ABASE, BTTAB, THETA
     D,             FUTURE(11), NVAR
      COMMON/P9PAL/P8PAL
      COMMON /AB6TAB6/AB6X(10),AB6Y(10),AB6Z(10),AB6T(1000),NTX6,NTY6,
     A NTZ6
      EQUIVALENCE(P7Q0,P8PA)
      IF (P8PA-P8PAL) 25,50,50
   25 P9PA=1.0
      GO TO 100
   50 A8A9=A8/A9
      IF (A8A9-1.0) 70,60,60
   60 AM9=1.0
      GO TO 75
   70 AM9=TABJ1(A8A9,A8A9T,XMACH9,10)
   75 P9PA=P8PA*(1.0+0.5*(GAMMAP-1.0)*AM9**2)** (-GAMMAP/(GAMMAP-1.0))
      IF (P9PA.LT.1.0) P9PA=1.0
  100 CAB=TAB33(A9*BTA10,P9PA,AM,AB6X,AB6Y,AB6Z,AB6T,NTX6,NTY6,NTZ6,
     A 10,10,10)
      CAB=CAB*AREA10/AMAX
      RETURN
      END
```

```
*FOLLOWING VARIABLES ARE EQUIVALENCED BUT NOT REFERENCED
P700
```

SUBPROGRAM LENGTH
000102

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

25	-	000007	50	-	000011	60	-	000015	70	-	000017
75	-	000023	100	-	000043						

EXTERNALS AND TAGS

TABU1	-	S00100	RBAREA-	-	S00200	TABU3	-	S00300	END.	-	S00400

BLOCK NAMES AND LENGTHS

XMACH9	-	000024	AREA10	-	000002	AMAX	-	000001	ABINP	-	000051
P8PAL	-	000001	ABTA86	-	002011						

VARIABLE ASSIGNMENTS

AB0T	-	000036C06	AB0X	-	000000C00	AB6Y	-	000012C06	AB6Z	-	000024C06
AM0X	-	000000C03	AM9	-	000101	AREA10	-	000000C02	A8	-	C00001C04
AB09	-	000100	AB09T	-	000012C01	A9	-	000015C04	BYA10	-	000001C02
FUTURE	-	000035C04	GAMMAP	-	000011C04	NTX6	-	002006C06	NTY6	-	C02007C06
NTZ6	-	002010C06	P8PA	-	000004C04	P8PAL	-	000000C05	P9PA	-	C00077
XMACH9	-	000000C01									

START OF CONSTANTS
000070

START OF TEMPORARIES
000073

START OF INDIRECTS
000077

SPACE REQUIRED TO COMPILE
035000

SUBJECT: SUBROUTINE DINTFR

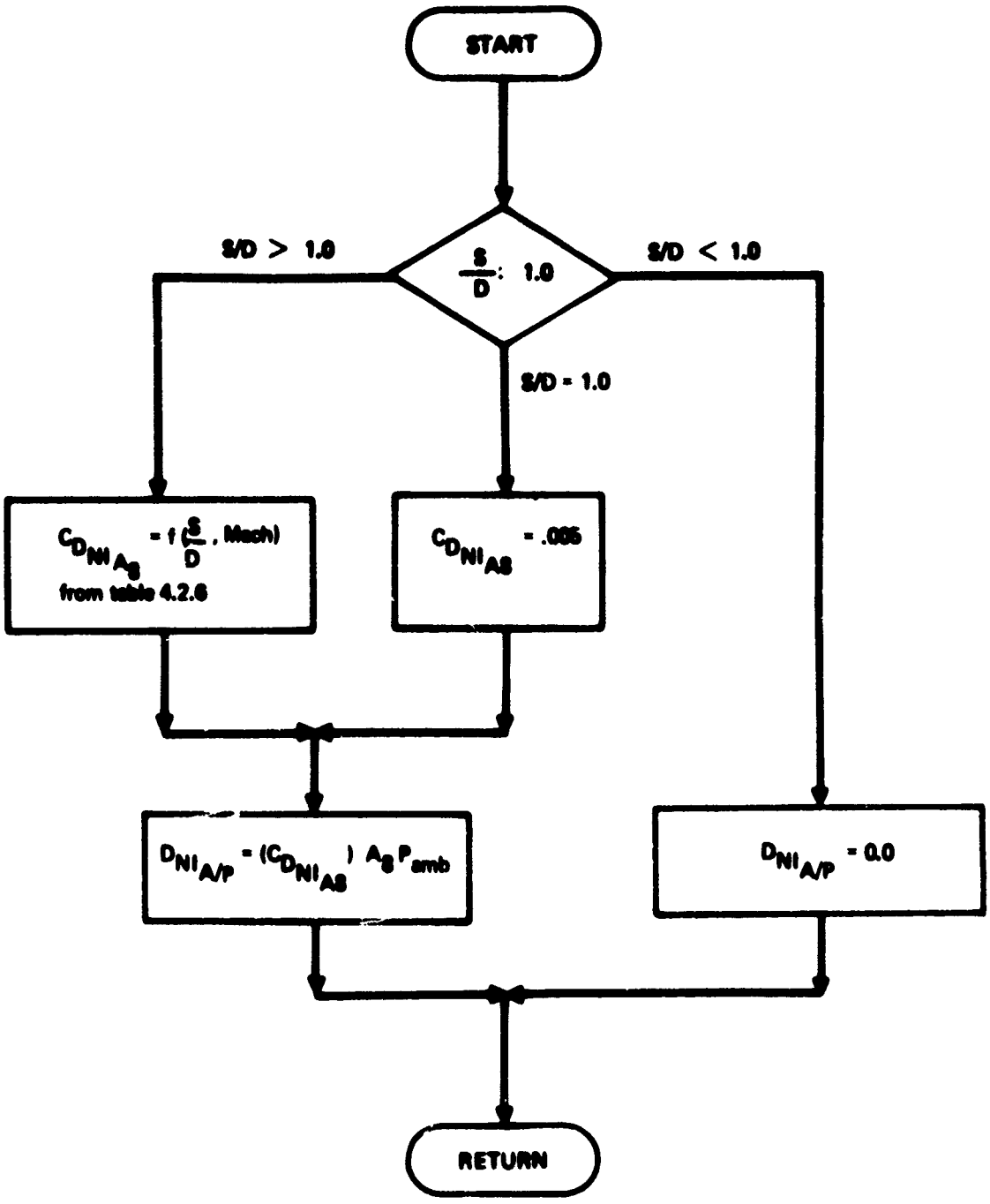
PURPOSE: SUBROUTINE DINTFR computes nozzle interference drag.

METHOD: The ratio S/D is interrogated to determine if it is greater than 1.0. If so, C_D is interpolated from Table 4.2.6 and total interference drag computed.

USAGE: CAL DINTFR

Input through COMMON/ABIN/ except D which is input in COMMON/DSPACG1. D is an output from the boattail routines except when $C_{D_{BT}}$ is interpolated from Table 4.2.1. In this latter case D ≡ 1.0, then nozzle interference drag can be input only as a function of Mach and some constant S/D ratio where the ratio is input instead of the nozzle centerline spacing for variable S.

SUBPROGRAMS: TABU2



Note: D computed by boattail drag routine

Figure 16: FLOW CHART FOR SUBROUTINE DINTFR

```
                      SUBROUTINE DINTFR
0000 02               COMMON/ABDRAG/ DBTAIL, DNI, DBASE
0000 02               COMMON/ABTABS/ABTX5(10),ABTY5(10),ABTZ5(10,10),NTX5,NTY5
0000 02               COMMON/ABINP/ AE6, A6, AE10, A10, P7QO, P17QO, FGIP, FGIF, PC,
                     A                GAMMAP, GAMMAF, XM, PAMB, Q, A9, A19, CFG, DMEP,
                     B                DMEF, PLUG, FLMMIX, DMAX, DMBASE, ZLPLUG, ZLBTAL,
                     C                S, ABASE, BTTAd, THETA
                     D,               FUTURE(11), NVAR
0000 02               COMMON/DSPACE/DSPACE
0000 02               DATA DSPACE/1.0/
0000 02               SRATIO=S/DSPACE
0000 04          100  IF (SRATIO-1.0)  110,120,130
0000 07          110  DNI=0.0
0000 10               GO TO 150
0000 11          120  DDI=.065
0000 13               GO TO 140
0000 13          130  DDI=TABD2(SRATIO,XM,ABTX5,ABTY5,ABTZ5,    NTX5,NTY5,10,10)
0000 25          140  DNI=4.34*DDI*AB*PAMB
0000 31          150  RETURN
0000 32               END
```

SUBPROGRAM LENGTH
000041

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
100 - 000084 110 - 000107 120 - 000011 130 - 000013
140 - 000025 150 - 000031

EXTERNALS AND TAGS
TABU2 - SC0100 END. - *SC0200

BLOCK NAMES AND LENGTHS
ABJRAG - 000003 ABTAB5 - 000172 ABINP - 000051 DSPACE - 000001

VARIABLE ASSIGNMENTS
ABTX5 - 000000C02 ABTY5 - 000012C02 ABTZ5 - 000024C02 A8 - 003001C03
COI - 000140 UNI - 000001C01 DSPACE - 000000C04 FUTURE - 000035C03
NTX5 - 000170C02 NTY5 - 000171C02 PAM3 - 000014C03 S - 003031C03
SRATIO - 000137 XM - 000013C03

START OF CONSTANTS
000033

START OF TEMPORARIES
000037

START OF INDIRECTS
000037

SPACE REQUIRED TO COMPILE
035300

SUBJECT: SUBRØUTINE DBASER

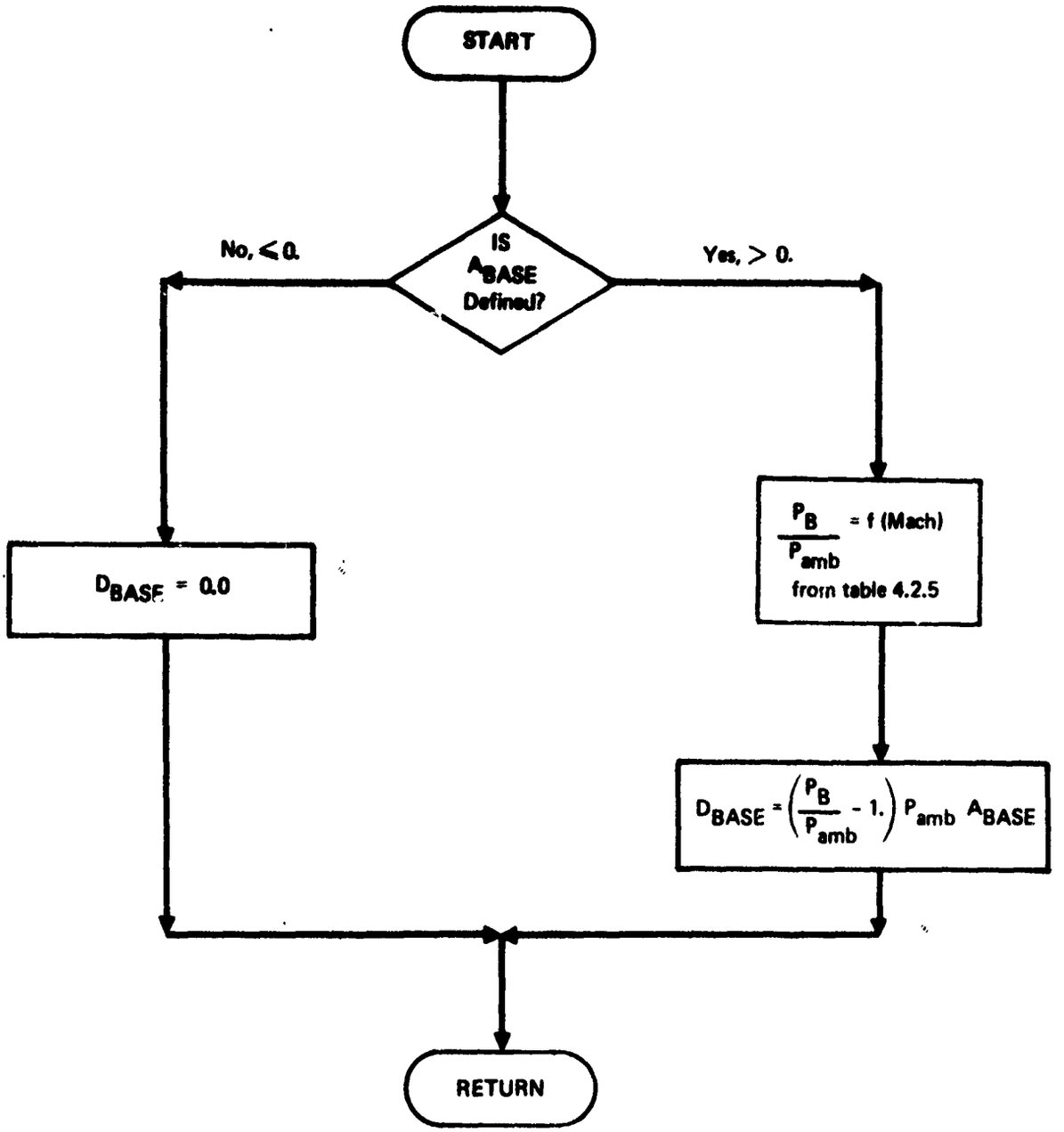
PURPØSE: SUBRØUTINE DBASER computes total airplane base drag.

METHØD: If a base area is input the base pressure ratio is interpolated from Table 4.2.5 and drag computed.

USAGE: CALL DBASER

Input form CØMMØN/ABIN/

SUBPRØGRAMS: TABU1



Note: A_{BASE} is input in field 8 of card 4.1.1

Figure 17: FLOW CHART FOR SUBROUTINE DBASER

```
                SUBROUTINE OBASER
000002          COMMON/ABTAB4/ABT4X(10),ABT4Y(10),NT4
000002          COMMON/ABINP/ AE8, A8, AE15, A18, P7QO, P17QO, FGIP, FGIF, PC,
               A              GAMMAP, GAMMAF, XM, PAMB, Q, A9, A19, CFG, DMEP,
               B              DMEF, PLUG, FLMMIX, DMAX, THICKB, ZLPLUG, ZLBTAL,
               C              S, ABASE, BTTA3, THETA
               D,             FUTURE(11), NVAR
000002          COMMON/ABJRAG/ OBTAIL, ONI, OBASE
000002          IF (ABASE) 10,10,20
000004      10  OBASE=0.0
000005          GO TO 30
000006      20  P3QPAM=TABU1(XM,ABT4X,ABT4Y,  NT4)
000011          OBASE=(P3QPAM-1.0)*PAMB*ABASE
000015      30  RETURN
000016          END
```

SUBPROGRAM LENGTH
000021

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
10 - 000004 20 - 000036 30 - 000015

EXTERNALS AND TAGS
TAG01 - S00100 END. - S00200

BLOCK NAMES AND LENGTHS
ABTAJ4 - 000025 ABINP - 000051 ABDRAG - 000003

VARIABLE ASSIGNMENTS
ABASE - 000032C02 ABT+X - 000000C01 ABT+Y - 000012C01 DBASE - 000002C03
FUTURE - 000035C02 NT+ - 000024C01 PAMB - 000014C02 PBQPAM - 000020
XM - 000013C02

START OF CONSTANTS
000017

START OF TEMPORARIES
000020

START OF INDIRECTS
000020

SPACE REQUIRED TO COMPILE
000300

164

```
                SUBROUTINE OBTTB
0000 02         COMMON/AMAX/AMAX
0000 02         COMMON/ABINP/ AE8, A8, AE18, A18, P7QO, P17QO, FGIP, FGIF, PC,
               A              GAMMAP, GAMMAF, XM, PAMB, 2, A9, A19, CFG, DMEP,
               B              DMEF, PLUG, FLWMIX, DMAX, THICKB, ZLPLUG, ZLBTAL,
               C              S, ABASE, BTTAB, THETA
               D,             FUTURE(11), NVAR
0000 02         COMMON/ABDRAG/ DBTAIL, DNI, DBASE
0000 02         COMMON/ABTAB1/ABTX1(10),ABTY1(10),ABTZ1(10,10),NTX1,NTY1
0000 02         COBETA=TAB2(XM,PC,ABTX1,ABTY1,ABTZ1,    NTX1,NTY1,10,10)
0000 14         DBTAIL=COBETA*Q*AMAX
0000 16         RETURN
0000 17         END
```

SUBPROGRAM LENGTH
000022

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
TABU2 - S00100 END. - S00200

BLOCK NAMES AND LENGTHS
AMAX - 000001 ABINP - 000051 ABORAG - 000003 ABTAB1 - 000172

VARIABLE ASSIGNMENTS
ABTX1 - 000000C04 ABTY1 - 000012C04 ABTZ1 - 000024C04 AMAX - 000000C01
COBETA - 000021 DBTAIL - 000000C03 FUTURE - 000035C02 NTX1 - 000170C04
NTY1 - 000171C04 PC - 000010C02 Q - 000015C02 XM - 000013C02

START OF CONSTANTS
000020

START OF TEMPORARIES
000021

START OF INDIRECTS
000021

SPACE REQUIRED TO COMPILE
035330

SUBJECT: **SUBRØUTINE FIXDIM**

PURPØSE: **SUBRØUTINE FIXDIM determines the dimensions of the nozzle throat and nozzle exit inputs.**

METHØD: **The input flag is interrogated and three flags are returned indicating input type and dimension.**

USAGE: **CALL FIXDIM (FLAG, J, K, L)**

FLAG - Input code value

J = 0 area input, = 1 diameter input

K = 0 inches, = 1 feet

L = 0 ignore, = 1 (A_9/A_8) input.

```
                      SUBROUTINE FIXDIM(FLAG,J,K,L)
0000 37               IFLAG=IFIX(FLAG)
0000 13               GO TO (1,2,3,4,5),IFLAG
0000 20             1 J=0
0000 21               K=0
0000 21               L=0
0000 22               RETURN
0000 22             2 J=0
0000 23               K=1
0000 23               L=0
0000 24               RETURN
0000 25             3 J=1
0000 26               K=0
0000 26               L=0
0000 27               RETURN
0000 30             4 J=1
0000 31               K=1
0000 32               L=0
0000 33               RETURN
0000 33             5 L=1
0000 34               RETURN
0000 35               END
```

SUBPROGRAM LENGTH
000041

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
1 - 000020 2 - 000022 3 - 000025 4 - 000030
5 - 000033

EXTERNALS AND TAGS
ACSOER.- SC0103 END. - S10200

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
IFLAG - 000040

START OF CONSTANTS
000036

START OF TEMPORARIES
000036

START OF INDIRECTS
000040

SPACE REQUIRED TO COMPILE
035200

SUBJECT: SUBRØUTINE ATMØS

PURPOSE: SUBRØUTINE ATMØS computes ambient pressure and temperature using empirical equations for the 1962 U. S. Standard Atmosphere.

METHØD: Altitude is tested to determine which region it is in, then the appropriate equations are applied. If altitude exceeds 100,000, an error is assumed and altitude will be divided by ten until it is within the required range.

USAGE: CALL ATMØS (ALT, TAMB, PAMB)

ALT - pressure altitude

TAMB - ambient temperature

PAMB - ambient pressure

SUBPRØGRAMS: EXP WARNING

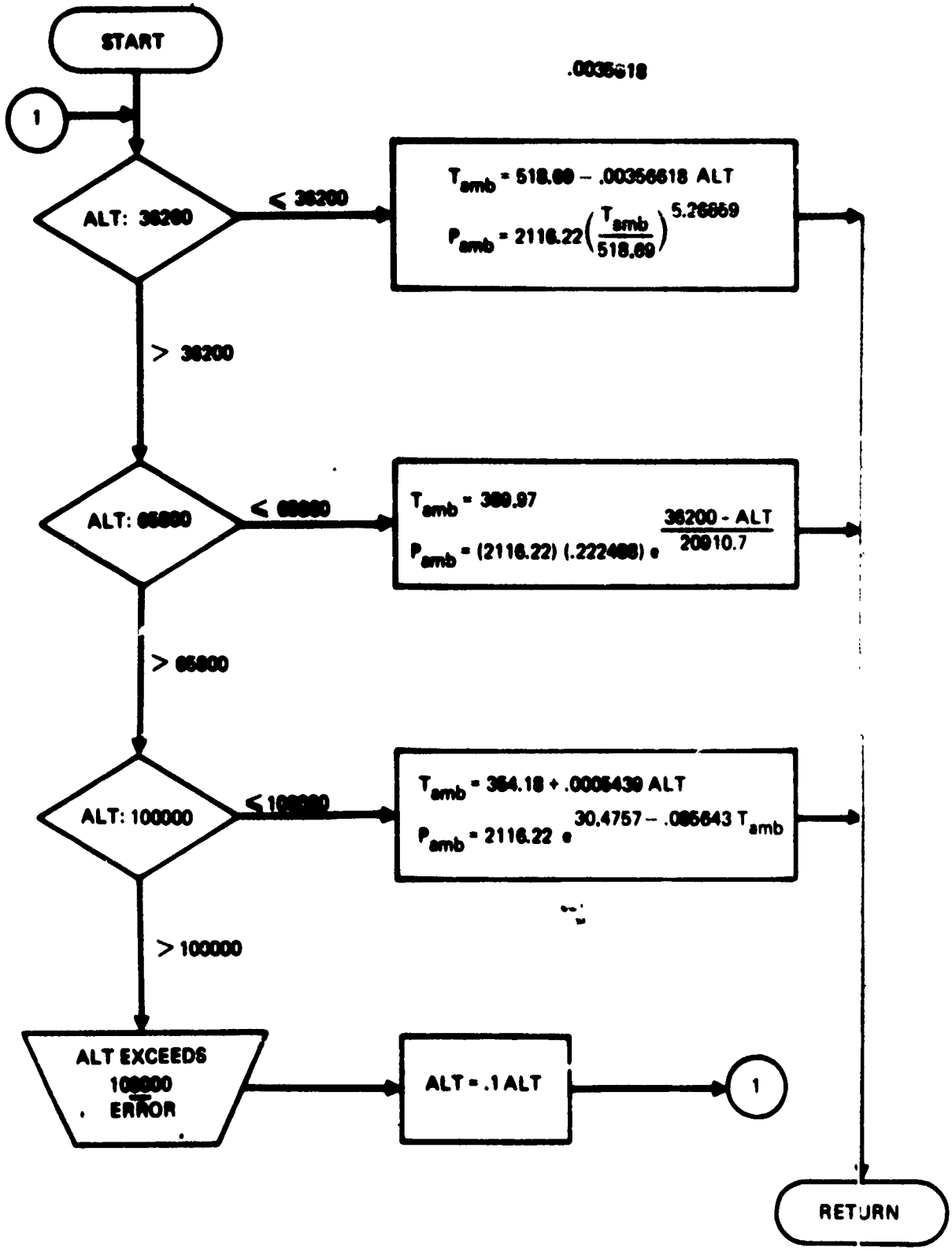


Figure 18: FLOW CHART FOR SUBROUTINE ATMOS

```
                SUBROUTINE ATMOS(ALT,TAMB,PAMB)                          COMPU150
0000 36       5 IF (ALT.GT.36200.) GO TO 10                              COMPU160
0000 12         TAMB=519.69-.00356616*ALT                                COMPU170
0000 14         PAMB=2116.22*(TAMB/518.69)**5.26659                      COMPU180
0000 21         GO TO 40                                                 COMPU190
0000 21      10 IF (ALT.GT.65800.) GO TO 20                              COMPU200
0000 25         TAMB=389.97                                              COMPU210
0000 25         PAMB=2116.22*.222468*EXP((36200.-ALT)/20911.7)           COMPU220
0000 34         GO TO 40                                                 COMPU230
0000 35      20 IF (ALT.GT.100000.) GO TO 30                             COMPU240
0000 41         TAMB=354.18*.0005439*ALT                                 COMPU250
0000 43         PAMB=2116.22*EXP(30.4757-.005643*TAMB)                   COMPU260
0000 52         GO TO 40                                                 COMPU270
0000 53      30 CALL WARNING                                             COMPU280
0000 54         ALT=ALT*.31                                              COMPU290
0000 57      700 FORMAT(1X,          *ALTITUDE INPUT EXCEEDS 100000 FT.  ALTITUDCOMPU300
                IE MODIFIED TO* F9.0)                                    COMPU310
0000 57         GO TO 5                                                  COMPU320
0000 60      40 RETURN                                                   COMPU330
0000 61         END                                                      COMPU340
```

SUBPROGRAM LENGTH
000122

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

5	- 000000	10	- 000021	20	- 000035	30	- 000053
40	- 000063	700	- 000106				

EXTERNALS AND TAGS

RBAREX.-	S00100	EXP	- S00200	WARNING-	S00300	END.	- S00400

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

START OF CONSTANTS
000062

START OF TEMPORARIES
000117

START OF INDIRECTS
000122

SPACE REQUIRED TO COMPILE
C3540

113

SUBJECT: SUBRØUTINE PERF

PURPØSE: SUBRØUTINE PERF controls the calculation of gross thrust.

METHØD: Mass flow, enthalpy, pressure, and relative pressure are developed for the nozzle throat. The thermodynamic properties at the throat are computed, then gross thrust computed from propulsive nozzle performance analysis.

USAGE: CALL PERF (WFT, WØ, PT8ØPA, TTØ, PAMB, FG, A8)

Input	WFT	-	Fuel flow lb/hr
	WØ	-	Air Flow lb/sec
	PT8ØPA	-	Nozzle throat pressure ratio
	TTØ	-	Total temperature degrees R
	PAMB	-	Ambient pressure PSF
Output	FG	-	Gross thrust lbs
	A8	-	Nozzle throat (given) ft^2

SUBPRØGRAMS: CHKRP GTHRST PRØFH

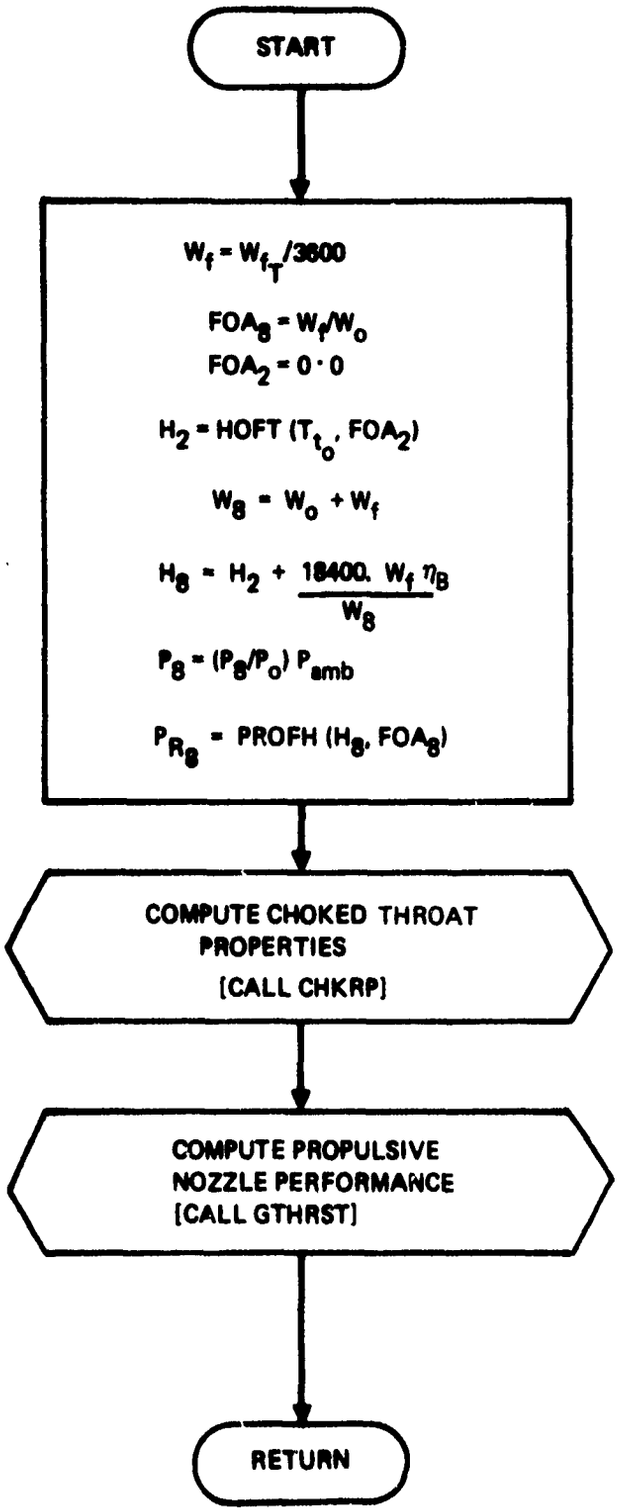


Figure 19: FLOW CHART FOR SUBROUTINE PERF

```
      SUBROUTINE PERF(WFT,WO,PT8OPA,TTO,PAMB,FG,A8)
0000 12      DATA XNB /.9957/
0000 12      DATA XNOZZ /1.0/
0000 12      DATA FOA2 /0.0/
0000 12      DATA EHVF /18400./
0000 12      DATA CD /1.0/
0000 12      DATA CV /1.0/
0000 12      WF=WFT/3600.
0000 13      FOA8=WF/WO
0000 14      H2=HOFT(TTO,FOA2).
0000 23      W9=WO+WF
0000 25      H8=H2+EHVF*WF*XNB/W8
0000 31      P8=PT8OPA*PAMB
0000 32      PR8=PROP4(H8,FOA8)
0000 36      CALL CHKRP(P8,H8,PR8,FOA8,PAMB,T8S,C8S,P8S,P8OPAM,P8OP8S)
0000 52      CALL GTHRST(XNOZZ,PR8,P8,H8,W8,FOA8,PAMB,CV,CD,T8S,P8S,C8S,W9,T9S,
     A     W9,A8,FG)
0000 77      RETURN
0001 00      END
      *DECK COMPUTE
```

SUBPROGRAM LENGTH
000131

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS

HOFT	- S00100	PROFM	- S00200	CHKRP	- S00300	GTHRST	- S00400
END.	- SCC5C0						

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A8	- 000000	CC	- 000110	CV	- 000111	C8S	- 000122
EMVF	- 000107	FOA2	- 000106	FOA8	- 000113	H2	- 000114
H8	- 000116	H9	- 000126	PR8	- 000120	P8	- 000117
P8OPAM	- 000124	P8OP8S	- 000125	P8S	- 000123	T8S	- 000121
T9S	- 000127	V9	- 000130	WF	- 000112	W8	- 000115
XN8	- 000104	XNOZZ	- 000105				

START OF CONSTANTS
000131

START OF TEMPORARIES
000132

START OF INDIRECTS
000134

SPACE REQUIRED TO COMPILE
C355JC

SUBJECT: SUBRØUTINE ØUTGØ

PURPØSE: SUBRØUTINE ØUTGØ prints a matrix of performance output.

METHØD: The output for NALT power settings at a Mach-altitude combination has been stored in the array ØUTP. A FØRMAT is built to print the variable name on both the left and right of the output columns. The matrix is printed and any indicated punching of MARK II data is done.

USAGE: CALL ØUTGØ (NALT)

NALT - Number of columns in output matrix = 10.

Input in CØMMØN

ØUTP (45,10)	output matrix
PCØDE	punched output flag
DA, TE	date, alphanumeric
TITLE (8)	run title
MACH	Mach number

Output

IWARN	Error message indicator introduced

SUBPRØGRAMS: MINØ MØD

```
                      SUBROUTINE OUTGO(NALT)
0000 33               COMMON/RESULT/OUTP(45,10),LABLE(45),NVAR
0000 33               COMMON/PCODE/PCODE
0000 33               COMMON/DATE/DA,TE
0000 33               COMMON/TITLE/TITLE(8)
0000 33               COMMON/NEWM/NEWM                                    OUTGO 50
0000 33               COMMON/IWARN/IWARN
0000 33               COMMON/INS/ MACH,OLDALT,CON
0000 33               DIMENSION FMT(3)                                    OUTGO140
0000 33               REAL MACH
0000 33               DATA NVAR/41/
0000 33               DATA LABLE / 4HCASE, 3HALT, 2HPS, 3HFNA, 64HFT RF, 4HSFCA, 4HFNRF,OUTGO 90
                     14HFRAM, 2HRF, 5HMILRF, 6HDINLET, 5HCDSPL, 5HCOBLD, 5HCOBYP,
                     26HCOINL , 4HONOZ, 4HCOBT, 6HCOBASE, 5HCOINT, 8HONOZ REF, 5HP8/P0,
                     32HA9, 2HA8, 3HCFG, 4HBETA, 8HFN INPUT, 8HWF INPUT, 9HSFC INPUT,
                     47HW INPUT, 5HW A8S, 8HFN/DELTA, 8HWF COR, 7HSFC COR, 4HTAMB,
                     54HPAMB, 3HTTO, 1HQ,          6HA8E/AC, 6HA8I/AC, 5HA0/AC, 6HSTATUS,
                     6 4*1H   /
0000 33               DATA BLANK/1H /                                     OUTGO150
0000 33               KOUT=MIN0(NALT,10)
0000 36               DO 10 I=1,3                                         OUTGO170
0000 10            10 FMT(I)=BLANK                                        OUTGO180
0000 14               WRITE(6,3) MACH,TITLE,DA,TE
0000 27               IWARN=0
0000 30             3 FORMAT(12H1MACH NUMBER,F7.4,5X,8A10,5X,A10,A2)
0000 30             6 FORMAT(1H )
0000 30               WRITE (6,6)                                         OUTGO290
0000 34               IF (KOUT-10) 20,50,50                               OUTGO300
                C     BUILD FORMAT                                        OUTGO310
0000 37            20 ENCODE(3),1,FMT) KOUT                               OUTGO320
0000 47             1 FORMAT(8H(1X,A10,I1,13HF10.3,5X,A10))               OUTGO330
0000 47               DO 30 K=1,NVAR                                      OUTGO340
0000 52               WRITE (6,FMT)  LABLE(K),(OUTP(K,J),J=1,KOUT),LABLE(K) OUTGO350
0000 73               IF (MOD(K,5).EQ.0) WRITE (6,6)                      OUTGO360
0001 05            30 CONTINUE                                            OUTGO370
0001 10               GO TO 65                                            OUTGO380
0001 10            50 DO 60 K=1,NVAR                                      OUTGO390
0001 12               WRITE (6,2)  LABLE(K),(OUTP(K,J),J=1,KOUT),LABLE(K) OUTGO400
0001 32               IF (MOD(K,5).EQ.0) WRITE (6,6)                      OUTGO410
0001 44            60 CONTINUE                                            OUTGO420
0001 47             2 FORMAT(1X,A10,10F13.3,5X,A10)                       OUTGO430
0001 47            65 IF (PCODE) 80,80,70                                 OUTGO440
                C     OUTPUT FOR PUNCH OR PLOTTING PROGRAM                OUTGO450
0001 51            70 IF (NEWM.GT.0) WRITE(7,150) (OUTP(3,J),J=1,KOUT)    OUTGO460
0001 67               IF (PCODE-1.0) 74,74,76                             OUTGO470
0001 72            74 WRITE (7,151) (OUTP(4,J),J=1,KOUT)                  OUTGO480
0002 06               WRITE (7,151) (OUTP(5,J),J=1,KOUT)                  OUTGO490
0002 22               GO TO 80                                            OUTGO500
0002 24            76 WRITE (7,151) (OUTP( 4,J),J=1,KOUT)                 OUTGO510
0002 40               WRITE (7,151) (OUTP( 5,J),J=1,KOUT)
0002 54               WRITE (7,151) (OUTP(29,J),J=1,KOUT)                 OUTGO530
0002 70            80 RETURN                                              OUTGO540
```

```
000271      153 FORMAT(10F7.2)                                  OUTG0550
000271      151 FORMAT(10F7.0)                                  OUTG0560
000271          END                                             OUTG0570
```

SUBPROGRAM LENGTH
000337

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000305	2	-	000312	3	-	000275	6	-	000303
10	-	000011	20	-	000037	30	-	000105	50	-	000110
60	-	000144	65	-	000147	70	-	000151	74	-	000172
76	-	000224	80	-	000270	150	-	000320	151	-	000322

EXTERNALS AND TAGS
OUTPTC.- 000100 OUTPTS.- 000260 END. - 000300

BLOCK NAMES AND LENGTHS

RESULT	-	000760	PCODE	-	000001	DATE	-	000002	TITLE	-	000010
NEWM	-	000001	IWARN	-	000001	INS	-	000003			

VARIABLE ASSIGNMENTS

BLANK	-	000332	DA	-	000000C03	FMT	-	000327	I	-	000334
IWARN	-	000000006	J	-	000336	K	-	000335	KOUT	-	000333
LABLE	-	000762C01	MASH	-	000000C07	NEWM	-	000000C05	NVAR	-	000757C01
OUTP	-	000000C01	PCODE	-	000000C02	TE	-	000001C03	TITLE	-	000000C04

START OF CONSTANTS
000272

START OF TEMPORARIES
000323

START OF INDIRECTS
000327

SPACE REQUIRED TO COMPILE
036600

SUBJECT: SUBRØUTINE WARNING

PURPØSE: SUBRØUTINE WARNING identifies the point to which the warning which follows applies.

METHØD: If no warning message has been written since the last printing of an output matrix, a heading is printed. In any event, the case number, Mach, altitude, and power setting is printed. The calling subprogram will then print the appropriate message.

USAGE: CALL WARNING

Input in CØMMØN

IWARN	Error message flag
CASE	Case number
ALT	Altitude
MACH	Mach number
PS	Power Setting

Output: STATUS Error flag for case.

```
                SUBROUTINE WARNING
0000 02         COMMON/IWARV/IWARN
0000 02         COMMON/OUTS/CASE,ALT,PS,OUTS(37),STATUS,EXTRA(4)
0000 02         COMMON/INS/ MACH,INS(2)
0000 02         REAL MACH
0000 02         DATA IWARN/0/
0000 02         IF (IWARN.EQ.0) WRITE(6,1)
0000 07       1 FORMAT(1H1,49X,24H*** WARNING MESSAGES *** )
0000 07         IWARN=1
0000 10         WRITE(6,2) CASE,MACH,ALT,PS
0000 24       2 FORMAT(8HJCASE NO,F5.0,10X,4HMACH,F6.3,10X,3HALT,F7.0,10X,2HPS,F7.
                A2)
0000 24         STATUS=-99.999
0000 26         RETURN
0000 26         END
          *DECK STORE
```

SUBPROGRAM LENGTH
000046

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
1 - 000031 2 - 000036

EXTERNALS AND TAGS
OUTPTC.- S00100 END. - S00200

BLOCK NAMES AND LENGTHS
IWARN - 000001 OUTS - 000055 INS - 000003

VARIABLE ASSIGNMENTS
ALT - 000031C02 CASE - 000000C02 EXTRA - 000051C02 INS - 000001C03
IWARN - 000000C01 MASK - 000100C03 OUTS - 000003C02 PS - 000002C02
STATUS - 000050C02

START OF CONSTANTS
000027

START OF TEMPORARIES
000046

START OF INDIRECTS
000046

SPACE REQUIRED TO COMPILE
035300

SUBJECT: SUBRØUTINE STØRE

PURPØSE: SUBRØUTINE STØRE moves the results for a single case to the output matrix.

METHØD: The CØMMØN block ØUTS contains the output for the case just computed with the individual variables in exactly the order to be printed. This data is transferred to CØMMØN block ØUTP.

USAGE: CALL STØRE (NALT)

NALT	-	number of cases at current Mach altitude = 10
ØUTS (45)	-	output for NALTTH case.
NVAR	-	number of ØUTS locations being used.

Output OUTP (RT,10) Output matrix.

```
                      SUBROUTINE STORE(NALT)
000003                COMMON/INS/ MACH,DLDALT,CON
000003                COMMON/OUTS/OUTS(45)
000003                COMMON/RESULT/OUTP(45,10),LABLE(45),NVAR
000003                DO 10 K=1,NVAR                                    STORE 60
000005             10 OUTP(K,NALT)=OUTS(K)                              STORE 70
000015                RETURN                                            STORE 80
000015                END                                               STORE 90
```

136

SUBPROGRAM LENGTH
000020

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
10 - 000005

EXTERNALS AND TAGS
END. - S00100

BLOCK NAMES AND LENGTHS
INS - 000003 OUTS - 000055 RESULT - 000760

VARIABLE ASSIGNMENTS
K - 000017 LABLE - 000702C03 NVAR - 000757C03 OUTP - 000800C03
OUTS - 000000C02

START OF CONSTANTS
000016

START OF TEMPORARIES
000016

START OF INDIRECTS
000017

SPACE REQUIRED TO COMPILE
000360

SUBJECT: SUBRØUTINE CHKRP

PURPØSE: SUBRØUTINE CHKRP calculates the thermodynamic properties at the throat and the total/static pressure ratio at the sonic condition.

METHØD: FUNCTIØN CØFH is called to compute sonic velocity. Then enthalpy is computed using the entry total enthalpy and the source velocity. Critical static temperature and relative pressure are computed as functions of enthalpy and fuel-air ratio. Pressure is derived from entry pressure and the relative pressure.

USAGE: CALL CHKRP (P1, H1, PR1, FØA1, PAM, TC, C, PC, P10PAM, PIPCC)

P1	Entry total pressure PSF
H1	Entry total enthalpy, BTU/lb_M
PR1	Entry relative pressure
FØA1	Entry fuel-air ratio
PAM	Ambient static pressure, PSF
TC	Critical static temperature, degrees R
C	Critical sonic velocity ft/sec
PC	Critical static pressure, PSF
P10PAM	P1/PAM
PIPCC	P1/PC

SUBPRØGRAMS: CØFH PRØFH TØFH

```
                SUBROUTINE CHKRP(P1,H1,PR1,FOA1,PAM,TC,C,PC,P1OPAM,P1PCC)          CHKRP
          C                                                                        CHKRP
          C**   THIS SUBROUTINE CALCULATES THERMODYNAMIC PROPERTIES AT THE THROAT  CHKRP
          C**    OF A CHOKED NOZZLE, AND THE TOTAL-TO-STATIC PRESSURE RATIO AT     CHKRP
          C**    THE SONIC CONDITION.                                              CHKRP
          C                                                                        CHKRP
          C**   THE NUMBER 1 IN A FORTRAN NAME REFERS TO THE NOZZLE INLET SIDE     CHKRP
          C                                                                        CHKRP
          C**   P = TOTAL PRESSURE, PSF                                           CHKRP
          C**   H1 = ENTRY TOTAL ENTHALPY, BTU/LBM                                CHKRP
          C**   PR = RELATIVE PRESSURE                                            CHKRP
          C**   FOA = FUEL/AIR RATIO                                              CHKRP
          C**   PAM = AMBIENT STATIC PRESSURE, PSF                                CHKRP
          C**   TC  = CRITICAL STATIC TEMPERATURE, DEGREES R.                     CHKRP
          C**   C = CRITICAL SONIC VELOCITY,FT/SEC                                CHKRP
          C**   PC = CRITICAL STATIC PRESSURE, PSF                                CHKRP
          C**   P1OPAM = P1/PAM                                                   CHKRP
          C**   P1PCC = P1/PC                                                     CHKRP
          C                                                                        CHKRP
          C                                                                        CHKRP
          C**   COFH IS A FUNCTION SUBROUTINE WHICH RETURNS CRITICAL SONIC        CHKRP
          C**    VELOCITY AS A FUNCTION OF TOTAL ENTHALPY AND FUEL/AIR RATIO      CHKRP
          C                                                                        CHKRP
0000015           C= COFH(H1,FOA1)                                                CHKRP
0000022           HC= H1- C*C*.199708E-4                                          CHKRP
          C                                                                        CHKRP
          C**   .199708E-4 = 1/(2)(G SUB 0)(J)                                    CHKRP
          C                                                                        CHKRP
0000025           TC=TOFH(HC,FOA1)                                                CHKRP
0000033           PRC=  PROFH(HC,FOA1)                                            CHKRP
0000041           P1PCC=  PR1/PRC                                                 CHKRP
0000042           PC=     P1/P1PCC                                                CHKRP
0000044           P1OPAM= P1/PAM                                                  CHKRP
0000046           RETURN                                                          CHKRP
0000047           END                                                             CHKRP
```

SUBPROGRAM LENGTH
000035

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
COFM - S00100 TOF4 - S00200 PROFM - S00300 END. - S00400

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
C - 000000 MC - 000053 PC - 000001 PRC - 000054
P1OPAM - 000002 P1PCC - 000003

START OF CONSTANTS
000036

START OF TEMPORARIES
000051

START OF INDIRECTS
000053

SPACE REQUIRED TO COMPILE
035330

130

SUBJECT: SUBRØUTINE GTHRST

PURPØSE: SUBRØUTINE GTHRST computes the performance of propulsive nozzles.

METHØD: Outlet conditions are computed, then nozzle ideal exit velocity. Nozzle throat static pressure is compared to ambient pressure to determine which temperature, pressure, and velocity to use in the calculation of nozzle throat area. Gross thrust is computed by the appropriate equation.

USAGE: CALL GTHRST (XNØZZ, PR1, P1, H1, W1, FØA1, PAM, CV, CD, TCS, PCS, VC, H2, T2S, V2, A, FG)

	XNØZZ -	1.0 for convergent-divergent nozzle; 2.0 for convergent nozzle.
	P121	Nozzle inlet relative pressure
	P1	Nozzle inlet total pressure PSF
	H1	Nozzle inlet total enthalpy BTU/LB_M
	W1	Nozzle inlet mass flow LB/SEC
	FØA1	Nozzle inlet fuel-air ratio
	PAM	Ambient static pressure PSF
	CV	Nozzle velocity coefficient
	CD	Discharge coefficient
	TCS	Nozzle throat static temperature degrees R
	PCS	Nozzle throat static pressure PSF
	VC	Nozzle throat velocity ft/sec
Output	H2	Nozzle outlet static enthalpy BTH/LB_M
	T2S	Nozzle outlet static temperature degrees R

Output (continued)

V2	Nozzle ideal exit velocity ft/sec
A	Nozzle throat area ft^2
FG	Gross thrust lb

SUBPRØGRAMS: AREA HØFPR SQRT

TØFH

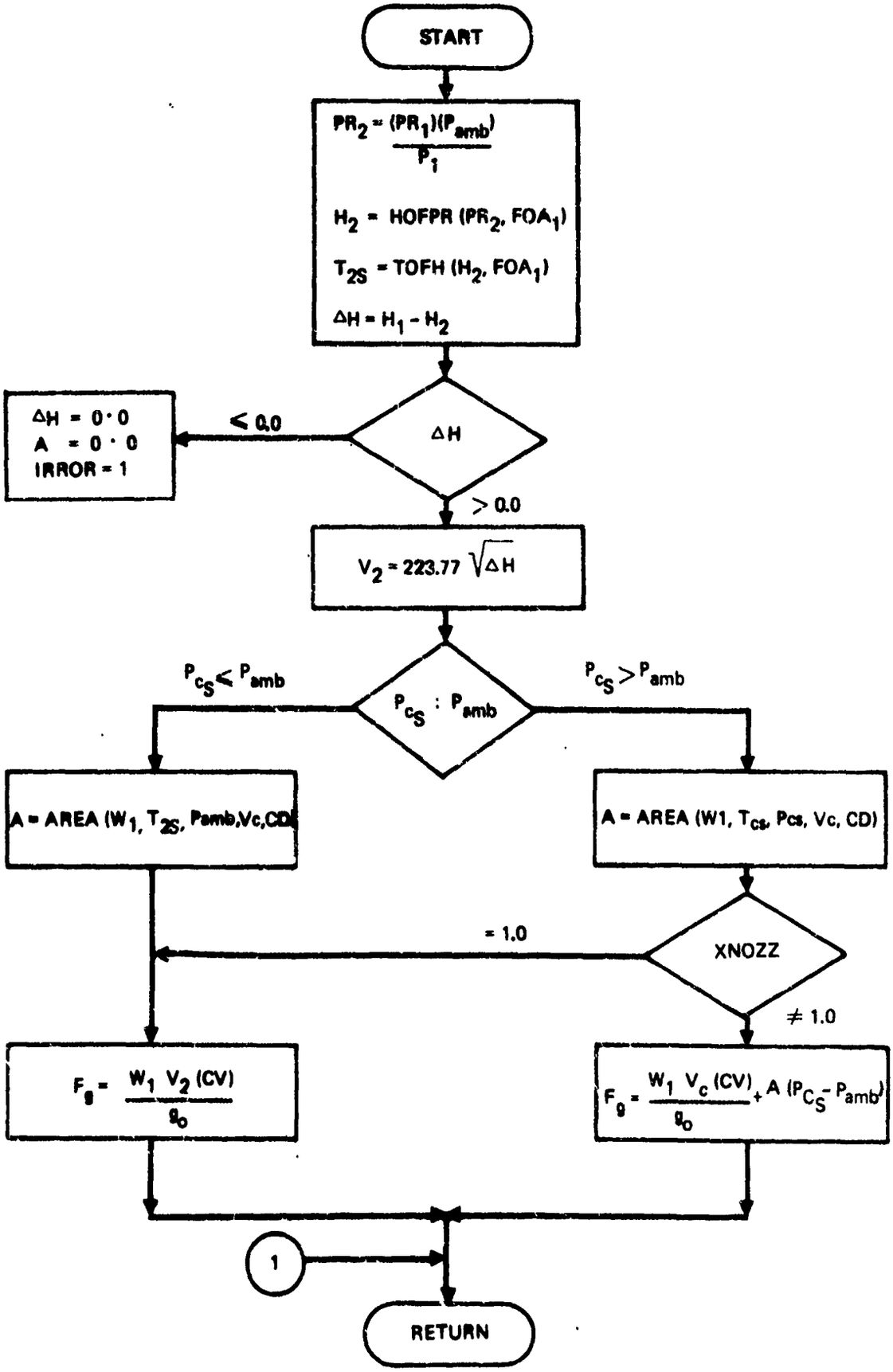


Figure 20: FLOW CHART FOR SUBROUTINE GTHRST

```
                      SUBROUTINE GTHRST(XNOZZ,PR1,P1,H1,W1,FOA1,PAM,CV,CD,      KR03
                     .TCS,PCS,VC,H2,T2S,V2,A,FG)                                GTHRST
                C                                                               GTHRST
                C**   AUTHOR          CAFFREY, M.             1969              GTHRST
                C                                                               GTHRST
                C**   MODIFIED        RITZAU, K.              FEBRUARY 1970     GTHRST
                C                                                               GTHRST
                C**   INPUTS                                                    GTHRST
                C      ICHOKE   = 1 FOR NOZZLE UNCHOKED , = 2 FOR NOZZLE CHOKED GTHRST
                C      INOZZ    = 1 CONVERGENT-DIVERGENT NOZZLE, = 2 CONVERGENT NOZZLE GTHRST
                C      PR1      = NOZZLE INLET RELATIVE PRESSURE                 GTHRST
                C      PAM      = AMBIENT STATIC PRESSURE, PSF                   GTHRST
                C      P1       = NOZZLE INLET TOTAL PRESSURE, PSF               GTHRST
                C      FOA1     = NOZZLE INLET FUEL TO AIR RATIO                 GTHRST
                C      H1       = NOZZLE INLET TOTAL ENTHALPY, BTU/LBM           GTHRST
                C      W1       = NOZZLE INLET MASS FLOW, LBM/SEC                GTHRST
                C      CV       = NOZZLE VELOCITY COEFFICIENT                    GTHRST
                C      AC       = NOZZLE THROAT AREA, SQUARE FEET                GTHRST
                C      PCS      = NOZZLE THROAT STATIC PRESSURE, PSF             GTHRST
                C      VC       = NOZZLE THROAT VELOCITY, FT/SECOND              GTHRST
                C      TCS      = NOZZLE THROAT STATIC TEMPERATURE, DEG. R.      GTHRST
                C                                                               GTHRST
                C**   OUTPUTS                                                   GTHRST
                C      H2       = NOZZLE OUTLET STATIC ENTHALPY, BTU/LBM         GTHRST
                C      T2S      = NOZZLE OUTLET STATIC TEMPERATURE, DEG. R.      GTHRST
                C      V2       = NOZZLE IDEAL EXIT VELOCITY, FT/SEC             GTHRST
                C      FG       = GROSS THRUST, LBF.                             GTHRST
                C      A        = NOZZLE THROAT AREA, SQUARE FEET.               GTHRST
                C                                                               GTHRST
                C**   THIS SUBROUTINE CALCULATES PERFORMANCE FOR THE PRIMARY AND GTHRST
                C     SECONDARY PROPULSIVE NOZZLES.                             GTHRST
                C                                                               GTHRST
0000 24               COMMON / ERMES/  IRROR(5)                                 ERMES
                C                                                               KR05
0000 24               PR2  =  PR1 * PAM / P1                                    GTHRST
0000 26               M2   =  MOFPR(PR2,FOA1)                                   GTHRST
0000 34               T2S  =  TOFM(M2,FOA1)                                     GTHRST
0000 43               DELH = H1 - H2                                            GTHRST
0000 45               IF(DELH .GT. 0.) GO TO 3                                  GTHRST
0000 50               DELH = 0.                                                 GTHRST
0000 50               IRROR(5) = 1                                              GTHRST
0000 51               A = 0.                                                    KR05
0000 52               RETURN                                                    KR01
0000 53             3 V2  =  223.77 * SQRT(DELH)                                KR04
                C                        223.77  = ((2)(G SUB 0)(J))**.5        GTHRST
                C                        .031081 = 1. /(G SUB C)                GTHRST
0000 56               IF (PCS.GT.PAM) GO TO 10                                  KR03
0000 57               A=AREA(W1,T2S,PAM,V2,CD)                                  KR03
0000 77             5 FG  =  .031081 * W1 * V2 * CV                             KR04
0001 03               RETURN                                                    KR03
0001 04            10 A=AREA(W1,TCS,PCS,VC,CD)                                  KR03
0001 15               IF (XNOZZ.EQ.1.) GO TO 5                                  KR03
```

```
CC0117          FG=.031081*CV*W1*VC+A*(PCS-PAM)                    KR03
CC0130          RETURN                                             GTHRST
CC0131          END                                                GTHRST
```

SUBPROGRAM LENGTH
000142

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
3 - 000053 5 - 000077 10 - 000104

EXTERNALS AND TAGS
HOFPR - SC0100 TOFH - S00200 SQRT - S00300 AREA - SC0400
END. - S00500

BLOCK NAMES AND LENGTHS
ERACS - 000005

VARIABLE ASSIGNMENTS

A	-	000011	CO	-	000002	CV	-	000001	DELH - 000141
FG	-	000012	H2	-	000006	IRROR	-	000000C01	PAM - 000000
PCS	-	000004	PR2	-	000140	TCS	-	000003	T2S - 000007
VC	-	000005	V2	-	000010				

START OF CONSTANTS
000132

START OF TEMPORARIES
000135

START OF INDIRECTS
000140

SPACE REQUIRED TO COMPILE
035000

SUBJECT: SUBRØUTINE DATA

PURPØSE: SUBRØUTINE DATA provides a card image output of all data cards input to TEM-333.

METHØD: Data cards are read from TAPE1 (INPUT), written on TAPE5 and OUTPUT. A card count is provided. Upon sensing an end-of-file of TAPE1, TAPE5 is end-filed and rewound. All subsequent input is from TAPE5. The INPUT file is equivalent to TAPE1 to provide a logical number for the EØF test.

USAGE: CALL DATA

INPUT file must be in desired position when subroutine is called.

```
                      SUBROUTINE DATA                                          DATA  10
                C  THIS DECK HAS BEEN MODIFIED TO TERMINATE UPON AN END OF FILE NOT END  DATA  20
0000 02               DIMENSION IWORD(9)                                       DATA  30
0000 02               REWIND 5                                                 DATA  40
0000 04               WRITE (5,1000)                                           DATA  50
0000 10               DO 100 I=1,100000                                        DATA  60
0000 12               READ (1,1001) IWORD                                      DATA  70
                C     IF (EOF(1))200,50                                        FTN
0000 17               IF (EOF,1) 200,50                                        RUN
0000 22            50 IF (AMOD(FLOAT(I),50.).NE.0.) GO TO 75                   DATA  90
0000 27               WRITE (6,1000)                                           DATA 100
0000 33            75 WRITE (6,1002) I,IWORD                                   DATA 110
0000 43               WRITE (6,1001)IWORD                                      DATA 120
0000 51           100 CONTINUE                                                 DATA 130
0000 54           200 END FILE 5                                               DATA 140
0000 56               REWIND 5                                                 DATA 150
0000 60               RETURN                                                   DATA 160
0000 61          1000 FORMAT (1H1*CARD*13X*1*9X*2*9X*3*9X*4*9X*5*9X*6*9X*7*9X*8*/1H   DATA 170
                     $        8X*12345678901234567890123456789012345678901234567890*  DATA 180
                     $          *1234567890123456789012345678901234567890*/1H )       DATA 190
0000 61          1001 FORMAT (A3,7A10,A7)                                     DATA 200
0000 01          1002 FORMAT (1H I4,4X,A3,7A10,A7)                            DATA 210
0000 61               END                                                      DATA 220
```

SUBPROGRAM LENGTH
000135

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
50 - 000022 75 - 000033 200 - 000054 1000 - 000071
1001 - 000114 1002 - 000117

EXTERNALS AND TAGS
REWINM.- 000100 OUTPTC.- S00200 INPUTC.- S00300 IFENDF.- S00400
ENDFIL.- S00500 END. - S00600

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
I - 000134 INDX0 - 000123

START OF CONSTANTS
000062

START OF TEMPORARIES
000122

START OF INDIRECTS
000123

SPACE REQUIRED TO COMPILE
000400

SUBJECT: SUBRØUTINE PLACIN

PURPØSE: SUBRØUTINE PLACIN reads a tabular array. A count of points is provided for independent variables.

METHØD: If the number of fields input, NF, is equal to zero, then data is read until the maximum allowable number of cards has been read or until a 1 is input in column 72. A field by field count is made on the last card image so that the total number of non-blank fields is returned in NF. If NF is positive, then NF values are read. All arrays are formatted ten field-seven digit.

USAGE: CALL PLACIN (A(1),NF,NCARD)

A - array to be filled

NF - number of fields to read or if zero on input, the number of fields read.

NCARD - the maximum number of cards to be read if array is full.

SUBPRØGRAM: KØUNT

```
                      SUBROUTINE PLACIN(A,NF,NCARD)
0000 36               COMMON/TAPENO/IN,IOUT
0000 36               COMMON/CARD/CARD(8)
0000 36               COMMON/IPTAB/IPTAB
0000 36               DIMENSION A(1)
0000 36               DATA IPTAB/1/
0000 36               IF (NF) 10,20,10
                C     READ DEPENDENT ARRAY - COUNT PROVIDED
0000 37            10 IK=0
0000 10               NCARDS=(NF-1)/10+1
0000 14               GO TO 30
                C     READ INDEPENDENT ARRAY - COUNT NO. INPUT FIELDS
0000 15            20 IK=1
0000 16               NCARDS=NCARD
0000 17            30 LO=1
0000 20               LH=10
0000 21               DO 50 I=1,NCARDS
0000 23               READ (IN,2) (A(I),I=LO,LH), II,ID
0000 42               IF (IPTAB.NE.0) WRITE(IOUT,3)(A(I),I=LO,LH),II,ID
0000 67               IF (IK) 35,40,35
0000 70            35 IF (NCARDS.EQ.1) GO TO 60
0000 72               IF (II) 40,60,40
0000 73            40 LO=LO+10
0000 75            50 LH=LH+10
0001 00               IF (IK.EQ.0) GO TO 70
0001 01               WRITE(IOUT,4) NCARDS
0001 07               IPTAB=1
0001 10               LH=LH-10
0001 12            60 NF=LH-10+KOUNT(A(LO),10)
0001 23            70 RETURN
0001 24             1 FORMAT (8A10)
0001 24             2 FORMAT(10F7.0,I2,A8)
0001 24             3 FORMAT(1X,10F12.5,I2,A8)
0001 24             4 FORMAT(+040XXXXX THE MAXIMUM NUMBER OF DATA CARDS,,I2,76H, FOR THE
                    1ABOVE ARRAY HAS BEEN READ WITHOUT ENCOUNTERING AN ARRAY TERMINATOR
                    2.//7X1164HCHECK TO SEE IF MISSING 1 IN COL 72 HAS CAUSED INPUT ERROR
                    3.  PROGRAM WILL CONTINUE TO READ INPUTS, BUT CARD SEQUENCE/7X20HMA
                    4Y NOW BE IN ERROR.//)
0001 24               END
```

SUBPROGRAM LENGTH
000236

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

1	-	000127	2	-	000131	3	-	000134	4	-	000137
10	-	000007	20	-	000015	30	-	000017	35	-	000070
40	-	000073	60	-	000112	70	-	000123			

EXTERNALS AND TAGS

INPUTC.	-	S00100	OUTPTC.	-	S00200	KOUNT	-	S00300	END.	-	S00400

BLOCK NAMES AND LENGTHS

TAPENO	-	000002	CARD	-	000010	IPTAB	-	000001			

VARIABLE ASSIGNMENTS

CARD	-	000000002	I	-	000203	ID	-	000205	II	-	000204
IK	-	000177	IN	-	000000C01	IOUT	-	000001C01	IPTAB	-	000000C03
LH	-	000202	LO	-	000201	NCARDS	-	000200			

START OF CONSTANTS
000125

START OF TEMPORARIES
000174

START OF INDIRECTS
000177

SPACE REQUIRED TO COMPILE
035730

SUBJECT: SUBRØUTINE TABL1

PURPØSE: SUBRØUTINE TABL1 inputs tables of the form F = f(x), table format 1.

METHØD: SUBRØUTINE PLACIN is called to read and count the independent array, then recalled to read the dependent array.

USAGE: CALL TABL1(T(1), MAX, N)

T - Table to be read

MAX - Maximum number of points in X array.

Output - N - Actual number of input points in X array.

STØRAGE: The table T is stored as follows:

Address	$T_{(1)}$	($T_{(2)}$ .... $T_{(Max)}$	$T_{(Max+1)}$	$T_{(2\ Max)}$
Content	$X_{(1)}$	$X_{(N)}$	$F_{(1)}$ ... $F_{(N)}$	

N MAX

T can be specified in the calling program by either:

DIMENSION T (2MAX) or CØMMØN/T/ TX(MAX),TY(MAX)

SUBPRØGRAMS: PLACIN

```
                SUBROUTINE TABL1(T,MAX,N)
0000036         DIMENSION T(1)
0000036         N=0
0000036         NCARD=(MAX-1)/10+1
0000012         CALL PLACIN(T(1),N,NCARD)
0000015         CALL PLACIN(T(MAX+1),N,NCARD)
0000022         RETURN
0000023         END
```

SUBPROGRAM LENGTH
000026

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
PLACIN - S00100 END. - S00200

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
NCARD - 000025

START OF CONSTANTS
000024

START OF TEMPORARIES
000024

START OF INDIRECTS
000025

SPACE REQUIRED TO COMPILE
035200

SUBJECT: SUBRØUTINE TABL2

PURPØSE: SUBRØUTINE TABL2 inputs tables of the form F = f(X,Y) square matrix, table format 2Q.

METHØD: SUBRØUTINE PLACIN is called to read and count the Y array, then again to read and count the X array. Then for each input Y point PLACIN is called to read NX points of the dependent array.

USAGE: CALL TABLE 2 (T, MAXX, MAXY, NX, NY)

T - - Table to be read

MAXX - Maximum number of points in X array

MAXY - Maximum number of points in Y array

Output NX - Actual number of X array points input

Output NY - Actual number of Y array points input.

STØRAGE: The table T is stored as follows:

Address	$T_{(1)}$ - - - $T_{(MAXX)}$ $T_{(MAXX+1)}$ - - $T_{(MAXX+MAXY)}$
Content	$X_{(1)}$ - - $X_{(NX)}$ $Y_{(1)}$ - - $Y_{(NY)}$
Address	$T_{(MAXX+MAXY+1)}$ - - $T_{(MAXX+MAXY+NX)}$ - $T_{(12MAXX+MAXY+1)}$
Content	$F_{(1,1)}$ - - - $F_{(NX,1)}$ - - - - $F_{(1,2)}$
Address	$T_{((NY+1)\ MAXX+MAXY+1)}$ $T_{((NY+1)MAXX+MAXY+NX)}$ - - $T_{((MAXY+1)MAXX+MAXY)}$
Content	$F_{(1,NY)}$ - - - - - - - - - $F_{(NX,NY)}$

T can be specified in the calling program by either:

DIMENSIØN T(MAXX+MAXY+(MAXX)(MAXY)) or

CØMMØN/T/TX(MAXX),TY(MAXY), TF(MAXX, MAXY)

SUBPRØGRAM: PLACIN

```
                SUBROUTINE TABL2(T,MAXX,MAXY,NX,NY)
0000 10         DIMENSION T(1)
0000 10         NY=0
0000 10         NCARD=(MAXY-1)/13+1
0000 14         CALL PLACIN(T(MAXX+1),NY,NCARD)
0000 17         NX=0
0000 23         NCARD=(MAXX-1)/13+1
0000 27         CALL PLACIN(T(1),NX,NCARD)
0000 31         ID=MAXX+MAXY+1
0000 36         DO 10 I=1,NY
0000 40         CALL PLACIN(T(ID),NX,NCARD)
0000 43      10 ID=ID+MAXX
0000 52         RETURN
0000 52         END
```

SUBPROGRAM LENGTH
000066

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
PLACIN - S00100 END. - S00200

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
I - 000057 ID - 000056 NCARD - 000055

START OF CONSTANTS
000053

START OF TEMPORARIES
000053

START OF INDIRECTS
000055

SPACE REQUIRED TO COMPILE
035400

SUBJECT: SUBRØUTINE TABL3

PURPØSE: SUBRØUTINE TABLE3 inputs tables of the form F = f(X,Y,Z), table format 3.

METHØD: SUBRØUTINE PLACIN is called to read and count the Z array, the Y array and the X array in turn. Then is recalled to read a dependent array corresponding to the X values for the first Y and Z; then for the second Y, etc. This is repeated for each Z value in turn.

USAGE: CALL TABL3 (T, MAXX, MAXY, MAXZ, NX, NY, NZ)

T - - Table to be read

MAXX - Maximum number of points in X array

MAXY - Maximum number of points in Y array

MAXZ - Maximum number of points in Z array

Output NX - Actual number of X array points input

Output NY - Actual number of Y array points input

Output NZ - Actual number of Z array points input

STØRAGE: The table T is stored as follows:

Address	T(1)	T(MAXX)	T(MAXX+1)	T(MAXX+MAXY)
Content	X(1) X(NX)		Y(1)	Y(NY)
Address	T(MAXX+MAXY+1)	T(MAXX+MAXY+MAXZ)	T(MAXX+MAXY+MAXZ+1)	
Content	Z(1)	Z(NZ)	F(1,1,1)	
Address	T(MAXX+MAXY+MAXZ+NX)- -		T(2MAXX+MAXY+MAXZ+1)	
Content	F(NX,1,1)		F(2,1,1)	

NX≤MAXX NY≤MAXY, NZ≤MAXZ

T can be specified in the calling program by either:

```
DIMENSIØN T(MAXX+MAXY+MAXZ+(MAXX)(MAXY)(MAXZ))
```

or

```
CØMMØN/T/TX(MAXX),TY(MAXY),TZ(MAXZ,
TF(MAXX,MAXY,MAXZ)
```

Note: dependent array stored in natural FØRTRAN order.

SUBPRØGRAM: PLACIN

```
                SUBROUTINE TABL3(T,MAXX,MAXY,MAXZ,NX,NY,NZ)
0000 12         DIMENSION T(1)
0000 12         IZ=MAXX*MAXY+1
0000 13         ITAB=IZ+MAXZ
0000 15         NZ=0
0000 15         NCARD=(MAXZ-1)/10+1
0000 22         CALL PLACIN(T(IZ),NZ,NCARD)
0000 27         MAXXY=MAXX*MAXY
0000 34         NY=0
0000 35         NCARD=(MAXY-1)/10+1
0000 41         CALL PLACIN(T(MAXX+1),NY,NCARD)
0000 45         NX=0
0000 51         NCARD=(MAXX-1)/10+1
0000 55         CALL PLACIN(T(1),NX,NCARD)
0000 61         DO 20 I=1,NZ
0000 66         ID=(I-1)*MAXXY+ITAB
0000 72         DO 10 K=1,NY
0000 74         CALL PLACIN(T(ID),NX,NCARD)
0001 00      10 ID=ID+MAXX
0001 07      20 CONTINUE
0001 12         RETURN
0001 13         END
```

SUBPROGRAM LENGTH
000125

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
PLACIN - S00180 END. - S00200

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

I	- 000122	ID	- 000123	ITAB	- 000117	IZ	- 000116
K	- 000124	MAXKY	- 000121	NCARD	- 000120	NZ	- 000000

START OF CONSTANTS
000113

START OF TEMPORARIES
000113

START OF INDIRECTS
000114

SPACE REQUIRED TO COMPILE
000300

SUBJECT: SUBRØUTINE TABL22

PURPØSE: SUBRØUTINE TABL22 inputs tables of the form F = f(X,Y) skewed matrix, table format 2K.

METHØD: SUBRØUTINE PLACIN is called to read and count the Y array. Then for each Y value in turn, PLACIN reads and counts and X array and the corresponding F values. The various X arrays need not have the same number of input points.

USAGE: CALL TABL22 (T,MAXY,MAXX,NY,NX)

T - - Table to be read

MAXY - Maximum of points in Y array

MAXX - Maximum of points in X array

Output NY - Actual number of Y array points input

Output NX - Array with actual numbers of X array points input

STØRAGE: T(1) T(MAXY) T(MAXY+1) T(MAXY+MAXX)

Y(1) Y(NY) X(1,1) X(NX(1),1)

T (MAXY+MAXX11) - - T(MAXY+(MAXY)(MAXX),1) - -

X(1,2) X(NX(NY),NY)

T(MAXY+(MAXX)(MAXY)+1 - - T(MAXY+MAXY(2MAXX))

F(1,1) F(NX(NY),NY)

T and NX are specified in the calling program by either:

DIMENSIØN T(MAXY+MAXY(2MAXX)), NX(MAXY)

or CØMMØN/T/TY(MAXY), TX(MAXX,MAXY), TF(MAXX,MAXY)

Note: X and Y have been reversed in the actual coding of this routine, but to be consistent with the write-ups for the other TABL routines, the outer loop variable is called Y in this write-up.

SUBPRØGRAM: PLACIN

```
                SUBROUTINE TABL22(T,MAXX,MAXY,NX,NY)
0000 10         DIMENSION T(1),NY(1)
0000 10         NX=6
0000 10         NCARD=(MAXX-1)/10+1
0000 14         CALL PLACIN(T(1),NX,NCARD)
0000 17         NCARD=(MAXY-1)/10+1
0000 26         K=MAXX+1
0000 27         IK=MAXX+MAXX*MAXY+1
0000 32         DO 100 I=1,NX
0000 34         NY(I)=6
0000 36         CALL PLACIN(T(K),NY(I),NCARD)
0000 44         CALL PLACIN(T(IK),NY(I),NCARD)
0000 56         K=K+MAXY
0000 62         IK=IK+MAXY
0000 63     100 CONTINUE
0000 66         RETURN
0000 66         END
              *DECK KOUNT
```

SUBPROGRAM LENGTH
000077

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
PLACIN - SC010C END. - S00200

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
I - 000076 IK - 000075 K - 000074 NCARD - 000073

START OF CONSTANTS
000067

START OF TEMPORARIES
000067

START OF INDIRECTS
000071

SPACE REQUIRED TO COMPILE
035400

```
                PROGRAM DSCRUB(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
          C
          C           *   PURPOSE - CALCULATES SCRUBBING DRAG                  *
          C           *                                                        *
          C           *   SUBPROGRAMS REQUIRED - DATABL1,DRAGAFT,SCBOUT        *
          C           *   RESTRICTIONS/LIMITATIONS - MAXIMUM 1000 CASES        *
          C           *   AWET NOT CALCULATED.
          C           *   AUTHOR     T.J. HARRIS          BCS ORG. G-2543 *
          C
          C
 000003         COMMON /PRINTNG/  D1(2)   ,P0     ,D2(2)  ,P25P0  ,D3(12) ,TT25    LAST  19
               1 ,D4(16) ,VJS2   ,D5(4)   ,RHOSEC ,D6(4)  ,REYSEC ,D7(43) ,DSCRBS  LAST  90
               2 ,D8(3)  ,DJTAFT ,D9(24)  ,XLCS   ,D10(6) ,XLAFT  ,D11(21),AWAFT   LAST 154
               3,D12(6),KAWET,D13(4),Q,VBT
 000003         COMMON /XCALC  /  D14(1)  ,P26P0  ,D15(3) ,D16(1) ,VJS1             LAST   7
 000013         COMMON /AMBIENT/  PT0     ,D17(1) ,V0                               LAST   3
 000003         COMMON /NACELL /  D18(3)  ,APJAFT ,D19(1) ,HFAN   ,HBT    ,D20(2)   LAST   9
               1                  ,HD     ,D21(1) ,ROD                              LAST  12
 000003         COMMON/SCOUT /TITLE(5),RDATE(2),XLINE(4,1000),BCSN,MAX,ID(2),FIRST

 000003         LOGICAL FIRST
          C
          C                 AWET NOT USED THIS TEST
 000003         KAWET=0.0
          C          INITIALIZE
 000004         MAX=0
 000005         KL=0
 000003         FIRST=.TRUE.
          C
          C        INPUT HEADER AND BASE GEOMETRY
 000007         READ(5,100) TITLE,BCSN
 000016         READ(5,200) AWAFT,HFAN,HBT,XLAFT,XLCS,HD,ROD,APJAFT,ID(1)
 000044         CALL SCBOUT(1)
          C
          C        INPUT VARIABLE DATA
 000046      10 READ(5,300) V0,Q,P0,PT0,P26P0,TT25,ID(2)
 000070         IF(V0.EQ.9999.) GO TO 1000
 000072         MAX=MAX+1
          C        WRITE INPUT CARD IMAGES
 000074         CALL SCBOUT(2)
          C        CALCULATE ONE CASE
 000075      20 CALL DRAGAFT
          C
          C        STORE RESULTS IN OUTPUT ARRAY
 000076         KL=KL+1
 000100         XLINE(1,KL)= DJTAFT
 000102         XLINE(2,KL)= DSCRBS
 000105         XLINE(3,KL)= VBT
 000107         XLINE(4,KL)=VJS2
 000111         GO TO 10
          C          WRITE OUTPUT ARRAY
 000112    1000 CALL SCBOUT(3)
```

```
      C
003114      100 FORMAT(2A10,10X,F5.0,15X)
003114      200 FORMAT(9F7.0,16X,A8)
003114      300 FORMAT(6F7.0,30X,A8)
003114          END
```

```
      SUBROUTINE SCBOUT(NCALL)
C
C                  *  PURPOSE - OUTPUT SCRUBBING DRAG INPUT DECK AND  *
C                  *            RESULTANT CALCULATIONS--50 LINES/PAGE. *
C
C                  *  ARG DEF.                                        *
C                  *     NCALL  CALL FLAG, WHERE:
C                  *        1=FIRST CALL-PRINT HEADER INFO.
C                  *        2=PRINT INPUT CARD IMAGES
C                  *        3=PRINT CALCULATIONS
C
C                  *  AUTHOR  T.D.HARRIS              BSC ORG. G-2543 *
C
000003        COMMON /PRINTNG/  D1(2)  ,P8     ,D2(2)  ,P25P8  ,D3(12) ,TT25    LAST  18
             1 ,D4(16) ,VJS2   ,D5(4)  ,RHOSEC ,D6(4)  ,REYSEC ,D7(43) ,DSCRBS LAST  90
             2 ,D8(9)  ,DBTAFT ,D9(24) ,XLCS   ,D10(6) ,XLAFT  ,D11(21),AWAFT  LAST 154
             3,D12(6),XAMET,D13(4),Q,VBT
000003        COMMON /XCALC  /  D14(1) ,P26P8  ,D15(3) ,D16(1) ,VJS1            LAST   7
000003        COMMON /AMBIENT/  PT8    ,D17(1) ,V8                              LAST   3
000003        COMMON /NACELL /  D18(3) ,APJAFT ,D19(1) ,HFAN   ,HBT    ,D20(2) LAST   9
             1                 ,HD     ,D21(1) ,ROD                           LAST  12
000003        COMMON/SCOUT /TITLE(5),RDATE(2),XLINE(4,1000),BCSN,MAX,ID(2),FIRST

000003        INTEGER PSN
000003        LOGICAL FIRST
C
C          INITIALIZE LINE AND PAGE COUNT
C
000003        IF(NCALL.GT.1) GO TO 20
000006        LCN=0
000006        PGN=0
000007        CALL DATE(RDATE(1),RDATE(2))
000012     10 WRITE(6,500)RDATE,TITLE,BCSN
C          CONSTANTS
000024        WRITE(6,510) AWAFT,HFAN,HBT,XLAFT,XLCS,HD,ROD,APJAFT, ID(1)
000052        GO TO 200
C
000054     20 IF(NCALL.EQ.3) GO TO 30
000056        LC=LC+1
000057        IF(LC.GE.50)WRITE(6,400)
C          VARIABLES FOR ONE CASE
000056        WRITE(6,700) V8,Q,P8,PT8,P26P8,TT25,ID(2)
000115        GO TO 200
C
C          OUTPUT ARRAY
000112     30 IF(.NOT.FIRST) GO TO 35
000114        BGCN=BCSN
000115        IF(BGCN.EQ.0.0)BGCN=1.0
000117        CSND=BGCN
C
000121     35 DO 100 K=1,MAX
000123        IF(FIRST)GO TO 40
```

```
000124          IF(LC.LE.50) GO TO 60
                C
                C       INCREMENT PAGE NO.-RESET LINE COUNTER
000127       40 PGN=PGN+1
000131          LC=0
000132          FIRST=.FALSE.
                C       NEW PAGE  PRINT HEADINGS
000133       50 WRITE(6,800) TITLE,RDATE,PGN
000145          WRITE(6,900)
                C       OUTPUT ONE DATA LINE
000151       60 WRITE(6,1000)CSNO,(XLINE(J,KL),J=1,6)
000166          LC=LC+1
000170          CSNO=CSNO+1.0
000172      100 CONTINUE
000175      400 FORMAT(1H1,*INPUT DECK-CONT.*)
000175      500 FORMAT(1H1,28X,*SCRUBBING DRAG INPUT CARD DECK*,1X,2A10,
               1//1H ,5A10,10X,F5.0)
000175      600 FORMAT(1H ,3F10.4,10X,A8)
000175      700 FORMAT(1H ,3F10.4,20X,A8)
000175      800 FORMAT(1H1,28X,*SCRUBBING DRAG RESULTS*,//10X,5A10,20X,*RUN DATE*,
               11X,2A10,10X,*PAGE NO. *,I4)
                C
000175      900 FORMAT(1H ,*CASE NO.*,15X,*DATAFT*,12X,*SCRBS*,12X,*  VBT  *,14X,
               1* VJS2 *)
000175     1000 FORMAT(1H ,F8.0,4F20.4)
                C
000175     2000 RETURN
000176          END
```

```
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                SUBROUTINE DRAGAFT
          C
          C     ******************

          C                 *  PURPOSE - CALCULATES SCRUBBING DRAG (AFTERBODY)  *
          C                 *
          C                 *  REFERENCE ITEM116  A.BANAY/N.PREMITT
          C
  000002          EXTERNAL AUX
  000002          DIMENSION Y(4)

  000002          COMMON /PRINTNG/  D1(2)  ,P0      ,D2(2)  ,P25P0   ,D3(14) ,TT25    LAST  19
                  1 ,D4(16) ,VJS2   ,D5(4)  ,RHOSEC ,D6(4)  ,REYSEC  ,D7(43) ,USCRBS  LAST  90
                  2 ,D8(9)  ,DUTAFT ,D9(24) ,XLCS   ,D10(6) ,XLAFT   ,D11(21),AWAFT   LAST 154
                  3,D12(6),XAMET,D13(4),Q,VBT
  000002          COMMON /XCALC  /  D14(1) ,P25P0  ,D15(3) ,D16(1) ,VJS1             LAST   7
  000002          COMMON /AMBIENT/  PTU    ,D17(1) ,V0                               LAST   3
  000002          COMMON /INTGRL /  FX1(16),X1(16) ,B      ,S      ,LANE
  000002          COMMON /NACELL /  D18(3) ,APJAFT ,D19(1) ,NFAN   ,NBT     ,D20(2) LAST   9
                  1                 ,NU    ,D21(1) ,ROD                              LAST  12

  000002          COMMON /DRAGCF /          XMACH(10)     ,VRAT(10)     ,DDDTB(10)
                  1                        ,CDIN(4,4,10) ,RDTB(10)     ,APJTB(10)
                  2                        ,CDBT(4,2,10) ,NDTB(10)     ,PFP0(10)
                  3                        ,RODTB(10)    ,CDAFT(3,3,10)

  000002          COMMON /JETCOR /          PFPATB(16)    ,BCONT1       ,BCONT2(16)
                  1                        ,ZKCON1(16)   ,ZKCON2(16)

  000002          DATA CVJ,GM1G/12013.6,0.2857143/
  000002          DATA TOL/0.01/ , RJFAFT/0.06/

  000002          XME2 = SQRT(5.*((P25P0)**GM1G-1.))

  000012          VJS2 = SQRT(CVJ*TT25*(1.-(1./P25P0)**GM1G))

  000023          STFAN = TT25/(1.+.2*XME2**2)
  000027          RHOSEC = P0/STFAN*0.0839
  000042          ZNU = 0.2323E-7*STFAN**1.5/(STFAN+216.)/RHOSEC
  000062          REYSEC = VJS2/ZNU*SQRT(NBT**2+XLAFT**2)

  000051          Y(1) = BCONT1

  000052          Y(2) = TB_U1(P25P0,PFPATB,BCONT2,2,16)
  000067          Y(3) = TB_U1(P25P0,PFPATB,ZKCON1,1,16)
  000063          Y(4) = TB_U1(P25P0,PFPATB,ZKCON2,2,16)

  000057          RATIO = (PTU/P0-1.)/0.49471
  000073          B  = RATIO*(Y(2)-Y(1))+Y(1)
  000105          ZK = RATIO*(Y(4)-Y(3))+Y(3)
  000131          XC = NFAN/ZK**(1./B)
```

```
      BRMONU = AWAFT/X_AFT*RHOSEC*ZNU**0.2
      COMP = (1.0+0.16*(ME2**2))**(-0.6)
      TE4P = 0.135*BRMONU*VJS2**1.6*(COMP*RJFAFT)
      DIFF = XLAFT-XC
      IF (DIFF) 19,10,12

   10 DRG2 = 0.
      DRG1 = TE4P*X_AFT**0.8
      GO TO 20

   12 E = (VJS2-VJ)/XC**3
      XCVJ = XC/VJS2**0.25
      STEP = 0.
      ARG1 = 0.
      X1(1)  = XC
      FX1(1) = XCVJ**0.2
      DIFF = DIFF/15.

      DO 14 I=2,15
      STEP = STEP+1.
      X1(I) = XC+DIFF*STEP
      LANE=1

      CALL LEGEND(AUX,X1(I-1),X1(I),TOL,ARG2,IERR)

      ARG1 = ARG1+ARG2
   14 FX1(I) = (ARG1+XCVJ)**0.2

      LANE=2

      CALL LEGEND(AUX,XC,XLAFT,TOL,ARG1,IERR)

      DRG2 = 0.325834*BRMONU*ARG1
      DRG1 = TE4P*XC**0.8

   15 SAVE=XC-X_OS
      IF (XC-X_OS) 18,21,20

   18 VBT = VJ+E*X_OS**3
      GO TO 22
   20 VBT = VJS2
      IF(Q.NE.0.0) GO TO 25
   22 Q = 0.5*R40SEC*VBT**2

   25 CD = TBLOS(40,P25P0,ROD,MDTB,PFP0,RODTB,CDAFT,1,1,1,3,3,10,3,3,10)
C
   26 WRITE(6,33) XC,SAVE,E,B
      WRITE(6,100) Q,CD,DBTAFT,XAMET

      IF (CD.LT.0.) CD = 0.
      DBTAFT = CD*Q*APJAFT
      DSDRDS = DRG1+DRG2
      IF (XAMET.EQ.0.) RETURN
```

```
000335          USCR3S = DS2R3S*XAMET/AMAFT
000340          DSTAFT = D.
000340
000340       99 FORMAT(14 ,* XC=*,F10.4,*XC-XLCS=*,F10.4,* E=*,F10.4,* B=*,F10.4)
000340      100 FORMAT(14 ,* D.CD.DRAFT.XAMET =*,F20.4,10X,*C/D ONLY    *)
000340          RETURN
000341          END DRAFT
```

EOF

```
      SUBROUTINE AJX(XX,FX)
000005      COMMON /INTGRL /  FX1(16),X1(16) ,B       ,E       ,LANE
000005      COMMON /AMBIENT/  PTO     ,D17(1) ,VB                    LAST  3
000005      DO TO(10,20),LANE
000013   10 FX= 1./(VB+E*XX**B)**.25
000025      RETURN
000025   20 FX=(VB+E*XX**3)**1.75/TBLU1(XX,X1,FX1,1,16)
0000-3      RETURN
0000-3      END
```

```
                SUBROUTINE DATABL1                                                  BLKDA 01
C               ******************
000002          COMMON /DRAGDF /        XMACH(13)     ,URAT(18)     ,DDOT9(18)    BLKDA 01
                1                      ,CDI4(4,4,18)  ,RDT3(18)     ,APJT3(18)    BLKDA 02
                2                      ,CDBT(4,5,18)  ,HDT8(18)     ,PFP8(18)     BLKDA 03
                3                      ,RDDT8(11)     ,CJAFT(3,3,10)               BLKDA 04

000002          COMMON /JETDDR /        PFPAT8(15)    ,BCONT1       ,BCONT2(16)   BLKDA 05
                1                      ,ZKCON1(10)    ,ZKCON2(16)                 BLKDA 06

000002          COMMON /NDZLDF /        FTP8(20)      ,DELCVP(20)   ,DELCVS(20)   BLKDA 07

000002          DIMENSION CDRS(200)                                                 BLKDA 08

000002          EQUIVALENCE (CDBT,CDRS)                                             BLKDA 09

000002          DATA XMAC4/0.75,0.80,0.85,0.90,6*1./ , URAT/0.5,0.6,0.7,0.8,6*1./,BLKDA 10
                $  DDIIW/0.78,0.80,0.82,0.84,0.86,0.87,0.88,0.89,0.90,0.91/         BLKDA 11

000002          DATA CDIW/                                                          BLKDA 12
                $ .0868,.0165,.0087,.0092,.0029,.0835,.0881,.0056,.0029,.0025,      BLKDA 13
                $ .0332,.0144,.0013,.0020,.0026,.0029,.0869,.0074,.0155,.0117,      BLKDA 14
                $ .0058,.0142,.0052,.0083,.0027,.0034,.0841,.0055,.0024,.0028,      BLKDA 15
                $ .0856,.0837,.0888,.0884,.0117,.0152,.0844,.0052,.0065,.0106,      BLKDA 16
                $ .0836,.0145,.0054,.0074,.0034,.0840,.0846,.0851,.0032,.0098,      BLKDA 17
                $ .0136,.0193,.0058,.0067,.0068,.0133,.0851,.0856,.0078,.0097,      BLKDA 18
                $ .0142,.0151,.0062,.0072,.0110,.0118,.0154,.0238,.0078,.0085,      BLKDA 19
                $ .0100,.0165,.0067,.0075,.0046,.0122,.0800,.0066,.0082,.0094,      BLKDA 20
                $ .0122,.0130,.0180,.0263,.0059,.0096,.0112,.0178,.0078,.0084,      BLKDA 21
                $ .0039,.0135,.0070,.0076,.0091,.0107,.0132,.0144,.0206,.0290,      BLKDA 22
                $ .0101,.0103,.0126,.0195,.0080,.0094,.0112,.0150,.0080,.0088,      BLKDA 23
                $ .0104,.0128,.0150,.0162,.0230,.0316,.0116,.0124,.0144,.0213,      BLKDA 24
                $ .0102,.0111,.0128,.0100,.0083,.0108,.0120,.0135,.0174,.0190,      BLKDA 25
                $ .0200,.0150,.0137,.0146,.0100,.0233,.0120,.0126,.0146,.0163,      BLKDA 26
                $ .0106,.0115,.0138,.0152,.0196,.0230,.0232,.0387,.0109,.0190,      BLKDA 27
                $ .0220,.0254,.0141,.0152,.0167,.0203,.0125,.0135,.0177,.0170/      BLKDA 28

000002          DATA RDTW/1.2 , 1.8 , 2.0 , 3.0 , 6*7.0 /,                          BLKDA 29
                $  APJTW/7.0,8.0,9.0,10.0,11.0,12.0,13.0,14.0,15.0,16.0/            BLKDA 30

000002          DATA (CDRS(I), I=001,100) /                                         BLKDA 31
                $ .0475,.2200,.3850,.0660,.0200,.0590,.2420,.4450,.0000,.0033,      BLKDA 32
                $ .0220,.2030,.0000,.0033,.0150,.0330,.0000,.0000,.0000,.0000,      BLKDA 33
                $ .0450,.2040,.3700,.5520,.0245,.0580,.2350,.4350,.0000,.0030,      BLKDA 34
                $ .0210,.1330,.0000,.0030,.0135,.0300,.0000,.0000,.0000,.0000,      BLKDA 35
                $ .0450,.1950,.3550,.5380,.0300,.0560,.2250,.4260,.0000,.0026,      BLKDA 36
                $ .0230,.1930,.0000,.0026,.0120,.0270,.0000,.0000,.0000,.0000,      BLKDA 37
                $ .0440,.1950,.3400,.5230,.0220,.0550,.2150,.4160,.0000,.0023,      BLKDA 38
                $ .0190,.1960,.0000,.0023,.0110,.0250,.0300,.0000,.0000,.0000,      BLKDA 39
                $ .0430,.1740,.3250,.5100,.0210,.0540,.2030,.4070,.0000,.0021,      BLKDA 40
                $ .0150,.1550,.0000,.0021,.0100,.0230,.0330,.0000,.0000,.0000/      BLKDA 41
```

```
000002      DATA (CORR(I), I=101,200) /                                          BLKDA 42
           $ .0415,.1550,.3100,.4950,.0200,.0530,.2000,.3980,.0000,.0020,       BLKDA 43
           $ .0145,.1770,.0090,.0020,.0090,.0210,.0000,.0000,.0090,.0000,       BLKDA 44
           $ .0400,.1550,.2350,.4820,.0130,.0520,.1900,.3880,.0010,.0020,       BLKDA 45
           $ .0130,.1720,.0000,.0020,.0080,.0190,.0000,.0000,.0080,.0000,       BLKDA 46
           $ .0330,.1460,.2800,.4660,.0180,.0500,.1800,.3790,.0090,.0020,       BLKDA 47
           $ .0120,.1570,.0000,.0020,.0070,.0160,.0000,.0000,.0080,.0000,       BLKDA 48
           $ .0365,.1360,.2700,.4540,.0150,.0490,.1750,.3700,.0090,.0020,       BLKDA 49
           $ .0110,.1520,.0000,.0020,.0060,.0140,.0080,.0000,.0080,.0000,       BLKDA 50
           $ .0350,.1260,.2550,.4400,.0145,.0480,.1650,.3600,.0010,.0020,       BLKDA 51
           $ .0100,.1560,.0000,.0020,.0050,.0120,.0090,.0000,.0090,.0000/       BLKDA 52

000002      DATA HGT3/0.03, 0.15, 8*0.21/ , PEPB/1.5, 2.2, 8*2.8/ ,              BLKDA 53
           $  ROJTB/2.0,3.0,4.0,5.0,6.0,7.0,8.0,9.0,10.0,11.0/                  BLKDA 54

000002      DATA COEFF/                                                          BLKDA 55
           $ .0135,.0195,.0135,.0300,.0625,.0630,.0420,.0990,.1100,             BLKDA 56
           $ .0135,.0145,.0153,.0220,.0375,.0370,.0280,.0570,.0630,             BLKDA 57
           $ .0095,.0110,.0122,.0145,.0215,.0240,.0170,.0310,.0330,             BLKDA 58
           $ .0070,.0082,.0130,.0090,.0120,.0155,.0095,.0155,.0225,             BLKDA 59
           $ .0052,.0050,.0082,.0053,.0085,.0100,.0054,.0072,.0184,             BLKDA 60
           $ .0040,.0050,.0070,.0040,.0050,.0070,.0040,.0050,.0043,             BLKDA 61
           $ .0032,.0045,.0063,.0032,.0045,.0063,.0032,.0045,.0063,             BLKDA 62
           $ .0030,.0045,.0059,.0030,.0045,.0059,.0030,.0045,.0059,             BLKDA 63
           $ .0030,.0045,.0055,.0030,.0045,.0055,.0030,.0042,.0055,             BLKDA 64
           $ .0030,.0045,.0055,.0030,.0045,.0055,.0030,.0045,.0055/             BLKDA 65

000002      DATA PEPATB/                                                         BLKDA 66
           $  1.4   ,1.6   ,1.8   ,2.0   ,2.2   ,2.4   ,2.6   ,2.8   ,        BLKDA 67
           $  3.0   ,3.2   ,3.4   ,3.6   ,3.8   ,4.0   ,4.2   ,4.4   /,       BLKDA 68

           $  DCONT1,DCONT2/-0.413,                                             BLKDA 69
           $ -1.050,-1.430,-1.210,-1.020,-0.878,-0.782,-0.712,-0.660,          BLKDA 70
           $ - .614,-0.576,-0.545,-0.521,-0.503,-0.488,-0.478,-0.470/          BLKDA 71

           $  ZKCON1,ZKCON2/                                                    BLKDA 72
           $  2.900 ,2.965 ,3.035 ,3.105 ,3.170 ,3.240 ,3.310 ,3.378 ,         BLKDA 73
           $  3.445 ,3.510 ,3.560 ,3.650 ,3.720 ,3.785 ,3.860 ,3.920 ,         BLKDA 74
           $  79.00 ,59.00 ,42.00 ,28.00 ,18.25 ,13.70 ,10.70 ,8.700 ,         BLKDA 75
           $  7.400 ,6.050 ,6.000 ,5.250 ,5.200 ,5.000 ,4.800 ,4.730 /         BLKDA 76

000002      DATA PTPO,DELCVP,DELCVS/      1.40  ,1.42  ,1.44  ,1.46  ,          BLKDA 77
           $  1.48  ,1.50  ,1.55  ,1.60  ,1.65  ,1.70  ,1.75  ,1.81  ,         BLKDA 78
           $  1.90  ,2.00  ,2.10  ,2.20  ,2.30  ,2.40  ,2.50  ,2.60  ,         BLKDA 79
           $  .03960,.00905,.00858,.00815,.01775,.00743,.00678,.00612,         BLKDA 80
           $  .00563,.00538,.00503,.00481,.01445,.00418,.00398,.00382,         BLKDA 81
           $  .00363,.00357,.00348,.00340,.01340,.00848,.00734,.00752,         BLKDA 82
           $  .00721,.00695,.00645,.00607,.00576,.00553,.00531,.00513,         BLKDA 83
           $  .00464,.00439,.00438,.00419,.00403,.00389,.00374,.00361/         BLKDA 84

000002      RETURN
.00013      END DATA8.1
```

SECTION III

DESCRIPTION OF FUNCTIONS AND LISTINGS

SUBJECT: FUNCTIØN AREA

PURPØSE: FUNCTIØN AREA computes flow area

METHØD: $\text{AREA} = \frac{R\ W\ T}{P\ V\ C_D} = \text{sq. ft.}$

USAGE: A = AREA (W, T, P, V, C_D)

W Inlet mass flow lb/sec

T Nozzle throat static temperature degrees R

P Nozzle throat static pressure lb/ft^2

V Nozzle throat velocity ft/sec

C_D Discharge coefficient = 1.0

RUN VERSION JUL 71 22.46.38. 72/08/23.

```
                FUNCTION AREA(M,T,P,V,CD)
0003 10         AREA=53.342*M*T/(P*V*CD)
0000 14         RETURN
0000 14         END
```

SUBPROGRAM LENGTH
000021

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
ENJ. - S00100

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
AREA - 000020

START OF CONSTANTS
000015

START OF TEMPORARIES
000016

START OF INDIRECTS
000020

SPACE REQUIRED TO COMPILE
035200

SUBJECT: **Thermodynamic function set; HØFT, TØFH, PRØFH, CØFH, and CØFHS.**

PURPØSE: The thermodynamic function set produces data from Keenan and Kaye Gas Tables to the program.

METHØD: A polynomial fit of the tabular data is used. The appropriate coefficients are determined by the checking the range of the input variables.

USAGE:

H = HØFT (T,FØA)

T = TØFH (H,FØA)

PR = PRØFH(H,FØA)

H = HØFPR(PR,FØA)

C = CØFH(HT,FØA)

C = CØFHS(HS,FØA)

H Enthalpy BTU/lb T temperature degrees R

FØA fuel/air ratio PR relativepressure

C sonic velocity ft/sec HT total enthalpy BTU/lb

HS static enthalpy BTU/lb

The fuel is assumed to be a hydrocarbon of composition, $C_N H_{2_N}$.

```
      FUNCTION HOFT(T, FOA)
C
C     AUTHOR                S. C. RAYL          JANUARY, 1971
C
C     SUBROUTINE CALCULATES ENTHALPY AS A FUNCTION OF TEMPERATURE AND
C         FUEL/AIR RATIO. FUEL IS A HYDROCARBON OF COMPOSITION C(N)H(2N)
C
C     INPUTS
C      T      = TEMPERATURE, DEG. R.
C      FOA    = FUEL/AIR RATIO
C
C     OTHER QUANTITIES
C      ER     = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
C                     STOICHIOMETRIC FUEL/AIR RATIO)
C
C     OUTPUTS
C      HOFT   = ENTHALPY, BTU/LBM.
C
000035      DIMENSION A(12), B(12), C(5)
000035      DATA (A(I), I=1,12) /
           A    -.6884879,      242.6325,      -6.752111,      1.337725,
           B    6.733997,       -2.351273,     25.2052667,     188.6858,
           C    43.76364,       -8.994387,     1.053822,       -.0524913 /
000035      DATA (B(I), I=1,12) /
           D    1.635584,       -7.261979,     28.96417,       -12.58440,
           E    2.512776,       0.,            -2.015578,      7.772518,
           F    8.240329,       -.0119861,     -.000119473,    0. /
000035      DATA (C(I), I=1,5) /
           G    .0354312,       -.1061944,     -.7570706,      .1192376,
           H    -.0085369  /
000035      I = 1
000035      IF (T .GT. 1440.) I=7
000011      TX = .001 * T
000012      HOFT = A(I) + TX*(A(I+1) + TX*(A(I+2) + TX*(A(I+3) + TX*(A(I+4)
           I   + TX*A(I+5))))
000024      IF (FOA .EQ. 0.)  RETURN
000027      XB = B(I) + TX*(B(I+1) + TX*(B(I+2) + TX*(B(I+3)+ TX*B(I+4))))
000037      XC = C(1) + TX*(C(2) + TX*(C(3) + TX*(C(4) + TX*C(5))))
000046      ER = 14.76315 * FOA
000050      HOFT = HOFT + ER *(XB + ER * XC)
000056      RETURN
000056      END
```

SUBPROGRAM LENGTH
001126

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
END. - 000106

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	-	000364	B	-	000108	C	-	000114	ER	-	000125
HOFT	-	000363	I	-	000121	TX	-	000122	XB	-	000123
XC	-	000124									

START OF CONSTANTS
000137

START OF TEMPORARIES
000162

START OF INDIRECTS
000163

SPACE REQUIRED TO COMPILE
003036

```
      FUNCTION TOFH(H, FOA)
C
C     AUTHOR                S. C. RAYL          JANUARY, 1971
C
C     SUBROUTINE CALCULATES TEMPERATURE AS A FUNCTION OF ENTHALPY AND
C         FUEL/AIR RATIO. FUEL IS A HYDROCARBON OF COMPOSITION C(N)H(2N)
C
C     INPUTS
C       H       = ENTHALPY, BTU/LBM.
C       FOA     = FUEL/AIR RATIO
C
C     OTHER QUANTITIES
C       ER      = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
C                       STOICHIOMETRIC FUEL/AIR RATIO)
C
C     OUTPUTS
C       TOFH    = TEMPERATURE,DEG. R.
C
000035        DIMENSION  A(12), B(12), C(12)
000305        DATA (A(I), I=1,12) /
              A     5.1366,         4041.695,       1473.279,       -6848.514,
              B     6174.385,       -1283.389,      -51.598,        4883.317,
              C     -2133.152,      1834.790,       -853.3329,      166.2833 /
000035        DATA (B(I), I=1,12) /
              D     -6.4550,        132.0567,       -2278.842,      4793.166,
              E     -3019.591,      0.,             18.1114,        -226.8851,
              F     -269.4827,      72.07638,       -4.734135,      0. /
000035        DATA (C(I), I=1,12) /
              G     .86787,         -25.76924,      342.9483,       -718.8386,
              H     377.1753,       0.,             2.851454,       -.5852354,
              I     45.33835,       -50.47864,      9.416551,       0. /
000035        I = 1
000035        IF (H .GT. 433.468)  I=7
000011        HX = .001 * H
000012        TOFH = A(I) + HX*(A(I+1) + HX*(A(I+2) + HX*(A(I+3) + HX*(A(I+4)
             J   + HX*A(I+5)))))
000024        IF (FOA .EQ. 0.) RETURN
000027        XB = B(I) + HX*(B(I+1) + HX*(B(I+2) + HX*(B(I+3) + HX* B(I+4))))
000037        XC = C(I) + HX*(C(I+1)+ HX*(C(I+2) + HX*(C(I+3) + HX*C(I+4))))
000046        ER = 14.7*FOA
000047        TOFH = TOFH + ER*(XB + ER * XC)
000055        RETURN
000055        END
```

SUBPROGRAM LENGTH
000134

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
END. - 000100

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	-	000063	B	-	000077	C	-	000113	ER	-	000133
MX	-	000130	I	-	000127	TOFM	-	000062	XB	-	000131
XC	-	000132									

START OF CONSTANTS
000056

START OF TEMPORARIES
000061

START OF INDIRECTS
000062

SPACE REQUIRED TO COMPILE
033600

```
      FUNCTION PROFM(H,FOA)
C
C     AUTHOR                S. C. RAYL          JANJARY, 1971
C
C     SUBROUTINE CALCULATES RELATIVE PRESSURE AS A FUNCTION OF ENTHALPY
C     AND FUEL/AIR RATIO.  FUEL IS A HYDROCARBON OF COMPOSITION C(N)H(2N)
C
C     INPUTS
C      H      = ENTHALPY,BTU/LBM
C      FOA    = FUEL/AIR RATIO
C
C     OTHER QUANTITIES
C      ER     = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
C                     STOICHIOMETRIC FUEL/AIR RATIO)
C
C     OUTPUTS
C      RELATIVE PRESSURE (DIMENSIONLESS)
C
000035       DIMENSION A(14),B(14),C(14)
000035       DATA(A(I), I=1,14)/
            A    -.035869328,   1.8093139,     -39.883328,    693.027519,
            B    1270.71594,    139.873914,    318.438817,    11.1827252,
            C    -95.853550,    315.653729,    16.586633,     1881.331732,
            D    182.538424,    36.178329/
000305       DATA(B(I),I=1,14)/
            E    .0275644584,   -1.324704,     26.341109,     -343.703710,
            F    868.624208,    -316.554050,   586.974753,    -13.1470397,
            G    114.6+9099,    -416.302627,   655.932099,    -639.272328,
            H    1147.663904,   -93.5704557/
000335       DATA(C(I),I=1,14)/
            I    .0012300336,   .034872785,    -2.427598,     51.427321,
            J    -212.709122,   196.971116,    -47.809145.    -2.7649713,
            K    21.051354,     -62.621283,    112.113531,    -146.323964,
            L    -24.432159,    113.212657/
000335       I = 1
000035       IF (H .GT. 433.408) I=8
000411       HX = .001 * H
000312       PROFM = A(I) + HX*(A(I+1) + HX*(A(I+2) + HX*(A(I+3) + HX*(A(I+4)
            M + HX*(A(I+5) + HX*A(I+6))))))
000025       IF (FOA .EQ. 0.) RETURN
000030       XB = B(I) + HX*(B(I+1) + HX*(B(I+2) + HX*(B(I+3) + HX*(B(I+4)
            N + HX*(B(I+5) + HX*B(I+6))))))
000043       XC = C(I) + HX*(C(I+1) + HX*(C(I+2) + HX*(C(I+3) + HX*(C(I+4)
            O + HX*(C(I+5) + HX*C(I+6))))))
000055       ER = 14.76015 * FOA
000056       PROFM = PROFM + ER *(XB + ER * XC)
000064       RETURN
000064       END
```

SUBPROGRAM LENGTH
000151

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
END. - 000130

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	-	000072	B	-	000110	C	-	000126	ER	-	000150
HX	-	000143	I	-	000144	PROFH	-	000071	XB	-	000146
XC	-	000147									

START OF CONSTANTS
000065

START OF TEMPORARIES
000076

START OF INDIRECTS
000071

SPACE REQUIRED TO COMPILE
035700

```
                 FUNCTION HOFPR(PR,FOA)
          C
          C      AUTHOR              S. C. RAYL         JANUARY, 1971
          C
          C      SUBROUTINE CALCULATES ENTHALPY AS A FUNCTION OF RELATIVE PRESSURE
          C      AND FUEL/AIR RATIO. FUEL IS A HYDROCARBON OF COMPOSITION C(N)H(2N)
          C
          C      INPUTS
          C       PR   (DIMENSIONLESS)
          C       FOA     = FUEL/AIR RATIO
          C
          C      OTHER QUANTITIES
          C       ER      = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
          C                      STOICHIOMETRIC FUEL/AIR RATIO)
          C
          C      OUTPUTS
          C       HOFPR = ENTHALPY,BTU/LBM.
          C
000035           DIMENSION A(35),B(35),C(35)
000035           DATA (A(I),I=1,35)/
               A      33.8895665,              8229296.08125,           174424086510.17,
               B      39482574933674.E+1,      187044.92625,            1245118736.7728,
               C      125373112.99358E+4,      68.4571986224,           1431962.971228,
               D      2594290477.8928,         564236131281.44,         9269.19768,
               E      9155035.4610 ,           816162150.1283,          128.4584235885,
               F      332566.053835,           63341581.05517,          1430605949.4649,
               G      1654.19465,              122937.4314 ,            1337680.1442,
               H      228.0305051173,          73274.9365524,           2076179.38711,
               I      6385535.86607,           146.4028128,             2388.88215,
               J      3680.004315,             344.525317671,           19428.9836934,
               K      37255.36617,             42903.93814,             23.857493,
               L      63.4822381,              16.11137356          /
000035           DATA (B(I),I=1,35)/
               M      3.1513220619,            77522.98151,             -1265401381.3742,
               N      150371247218+9.,         -3524142666519.E+4,      3156140032377.E+7,
               O      -420177464182.E+12,      5.3216322373,            4442.46644,
               P      -12773345.57330,         13661742492.098,         -8005847874970.8,
               Q      24237366726112.E+2,      -295329615C743.E+5,      6.9061722977,
               R      -2231.88192,             151430.63426,            -11443244.18617,
               S      518153325.37219,         -19756355588.259,        2750013535311.36,
               T      3.0360291754,            -1225.466378,            19666.3119977,
               U      -274328.64924,           243721.36752,            -11698073.15172,
               V      24243973.37542,          -11.3321587185,          -488.005311,
               W      1427.332624,             -3464.404466,            5272.642728,
               X      -4413.34556,             1543.46441           /
000035           DATA (C(I),I=1,35)/
               Y      -.1150147855,            -5043.33861,             62170753.91263,
               Z      -453319426965.92,        17161958261022.E+2,      -25446185274924.E+5,
               A      0.,                      -.3093113042,            -337.366526,
               B      1655806.765252,          -901754807.71009,        365338336676.42,
               C      -5631748439293.,         0.,                      -.4758566541,
               D      300.058573,              -13159.274646,           663816.87816,
```

```
      E    -23371058.45027,     393717503.24254,     0.,
      F    .0847566728,         184.780400,          -2154.622705,
      G    22002.85508,         -127377.31427,       364481.536484,
      H    3.,                  2.6579347583,        81.811924,
      I    -175.85589,          302.29717,           -292.89636,
      J    117.1980897,         0.                   /
000035      I=1
000035      IF(PR .GT. 2.2488) I=8
000011      IF(PR .GT. 22.5614)I=15
000015      IF(PR .GT. 181.1686) I=22
000021      IF(PR .GT. 1208.6219)I=29
000025      PRX= .0001 * PR
000026      MOFPR =(A(I) + PRX*(A(I+1) + PRX*(A(I+2) + PRX* A(I+3))))/
           L (1. + PRX *(A(I+4) + PRX *(A(I+5) + PRX* A(I+6))))
000045      IF (FOA .EQ. 0.) RETURN
000047      XB = B(1) + PRX*(B(I+1) + PRX*(B(I+2) + PRX*(B(I+3) + PRX*(B(I+4)
           L + PRX*(B(I+5) + PRX* B(I+6)))))
000062      XC = C(I) + PRX*(C(I+1) + PRX*(C(I+2) + PRX*(C(I+3) + PRX*(C(I+4)
           M + PRX* C(I+5)))))
000072      ER = 1.476315 * FOA
000074      MOFPR = MOFPR + ER * (XB + ER * XC)
000132      RETURN
000132      END
```

SUBPROGRAM LENGTH
000273

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
END. - S00103

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	-	000115	B	-	000160	C	-	000223	ER	-	000272
MOFPR	-	000114	I	-	000206	PRX	-	000267	XB	-	000270
XC	-	000271									

START OF CONSTANTS
000133

START OF TEMPORARIES
000112

START OF INDIRECTS
000114

SPACE REQUIRED TO COMPILE
035500

```
      FUNCTION COFM(H, FOA)
C
C     AUTHOR                S. C. RAYL          JANJARY, 1971
C
C     FUNCTION CALCULATES CRITICAL (MACH = 1) SONIC VELOCITY AS A
C         FUNCTION OF TOTAL ENTHALPY AND FUEL/AIR RATIO. FUEL IS A
C         HYDROCARBON OF COMPOSITION C(N)H(2N)
C
C     INPUTS
C      H      = TOTAL ENTHALPY, BTU/LBM
C      FOA    = FUEL/AIR RATIO
C
C     OTHER QUANTITIES
C      ER     = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
C                  STOICHIOMETRIC FUEL/AIR RATIO)
C
C     OUTPUTS
C      COFM   = CRITICAL SONIC VELOCITY
C
000035      DIMENSION A(30), B(30), C(30)
000035      DATA (A(I), I=1,30) /
           A    287.73365,     8768.10549,    -34774.99027,  122050.46815,
           B    -294038.34704, 223329.52375,  677.24353,     2627.47247,
           C    3868.23502,    -30713.46231,  46276.23471,   -25109.73645,
           D    331.70145,     6382.33657,    -10614.35870,  11816.68645,
           E    -6582.33102,   1316.05773,    3106.04552,    -10972.51279,
           F    32551.23785,   -41335.83319,  25630.75433,   -6295.60766,
           G    1693.16258,    -922.73017,    5705.89734,    -6352.74300,
           H    3242.37510,    -641.76641/
000035      DATA (B(I), I=1,30) /
           I    -13.44753,     271.37288,     -3950.09389,   13597.19441,
           J    -18575.42276,  6312.31213,    -347.90538,    4612.97154,
           K    -26154.31465,  73169.29856,   -92269.74016,  47771.49423,
           L    4883.39498,    -39756.07127,  129604.13722,  -211656.24957,
           M    172229.93669,  -55795.54381,  -8453.13287,   52978.95471,
           N    -133354.83771, 106887.42429,  -104113.26372, 25939.96315,
           O    1115.77024,    -4777.37150,   7393.33292,    -5636.29346,
           P    2403.40473,    -283.33993/
000035      DATA (C(I), I=1,30) /
           Q    1.92321,       -52.25002,     642.8933+,     -2059.97789,
           R    2341.03300,    0.,            -67.63421,     722.55329,
           S    -2699.11061,   4459.49800,    -2756.97349,   0.,
           T    7.9+337,       -31.91254,     130.83947,     -121.99847,
           U    39.33443,      0.,            -193.33757,    352.91171,
           V    -1393.33069,   1330.86643,    -283.64163,    0.,
           W    -969.73745,    1903.10144,    -2139.30434,   1333.00472,
           X    -316.32984,    0. /
000035      I = 1
000035      IF (H .GT. 291.522) I=7
000111      IF (H .GT. 915.820) I=13
000215      IF (H .GT. 703.331) I=19
000321      IF (H .GT. 914.634) I=25
```

```
0000025          HX = .001 * H
0000026          COFH = A(I) +HX*(A(I+1) + HX*(A(I+2) + HX*(A(I+3) + HX*(A(I+4)
                V    +HX*A(I+5))))
0000040          IF (FOA .EQ. 0.)  RETURN
0000043          XB = B(I) + HX*(B(I+1) +HX*(B(I+2) + HX*(B(I+3) + HX*(B(I+4)
                Z    + HX*B(I+5))))
0000054          XC = C(I) + HX*(C(I+1) + HX*(C(I+2) + HX*(C(I+3) + HX* C(I+4))))
0000063          ER = 14.76315 * FOA
0000075          COFH = COFH + ER *(XB + ER * XC)
0000073          RETURN
0000073          END
```

SUBPROGRAM LENGTH
000243

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
END. - SC0106

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	- 000104	B	- 000142	C	- 000200	COFM	- 000103
ER	- 000242	HX	- 000237	I	- 000236	XB	- 000240
XC	- 000241						

START OF CONSTANTS
000174

START OF TEMPORARIES
000102

START OF INDIRECTS
000103

SPACE REQUIRED TO COMPILE
035436

182

```
      FUNCTION COFHS(H,FOA)
C
C     AUTHOR                S. C. RAYL          JANUARY, 1971
C
C     SUBROUTINE CALCULATES SONIC VELOCITY AS A FUNCTION OF STATIC ENTHALPY
C     AND FUEL/AIR RATIO.  FUEL IS A HYDROCARBON OF COMPOSITION C(N)H(2N)
C
C     INPUTS
C      H       = STATIC ENTHALPY, BTU/LBM.
C      FOA     = FUEL/AIR RATIO
C
C     OTHER QUANTITIES
C      ER      = EQUIVALENCE RATIO (FUEL/AIR RATIO DIVIDED BY
C                      STOICHIOMETRIC FUEL/AIR RATIO)
C
C     OUTPUTS
C      COFHS   = SONIC VELOCITY, FT/SEC
C
000035        DIMENSION A(35),B(35),C(35)
000035        DATA (A(I),I=1,35)/
             A     283.3265,       10797.7055,     -56078.635,     276156.237,
             B     -901657.263,    1633251.076,    -1228974.245,   2725.0400,
             C     -32.52.727,     2ou922.877,     -1003542.394,   2109408.2355,
             D     -2326394.359,   1355523.027,    11500.9117,     -122697.6866,
             E     516333.097,     -161092s.3455,  234755s.419,    -1814548.366,
             F     561518.498,     1s44.6893,      -2412.4025,     18330.927,
             G     -37.71.343,     3965u.481,      -21644.153,     4824.6501,
             H     -1o24o8.284,    1034497.5o2,    -2414549.5854,  3305968.2671,
             I     -21o2o84.7391,  7o2759.3932,    -12125u.4652    /
000035        DATA (B(I),I=1,35)/
             J     o.372077,       -498.4256,      7412.7167,      -90431.6578,
             K     +96+66.8757,    -1270950.521,   1247375.8983,   -8554.800795,
             L     1+7761.2639,    -1o50418.5291,  4023685.5963,   -8526354.2777,
             M     +2o534+1.0517,  -4443037.3202,  11026.5075,     -111568.6151,
             N     +57335.5561,    -972o27.1173,   1117179.3339,   -644185.3436,
             O     139o46.+566,    +296.7749,      -33od9.0419,    100431.8669,
             P     -1593+1.3343,   1+u429.43s1,    -o5+73.2535,    12549.6235,
             Q     s1co39.3101,    -45oo516.3865,  1073187.740,    -13357663.8456,
             R     936+333.7488,   -3496414.3o17,  543102.1273     /
000035        DATA (C(I),I=1,35)/
             S     2.1o3333,       -44.231873,     231.5120,       6430.1547,
             T     -2e83o.9453,    17o+59.3312,    -1+4o62.4619,   5217.8311,
             U     -9o357.3478,    6+8785.+6o6,    -24od958.2281,  52533+6.o605,
             V     -5+2533o.5584,  27677d9.3+85,   -30971.4o61,    3+3020.2405,
             W     -1575o3.1954,   3346352.6+o1,   -+2574+1.7324,  3815969.8088,
             X     -1+4+953.8603,  -+673+.5059,    39099.2198,     -1o3777.7593,
             Y     178789.427o,    -1o4219.3519,   79911.5355,     -16096.9183,
             Z     -712815.17432,  4o6761.3184,    -9372293.3747,  11677315.0170,
             1     -o173211.0209,  33+6901.8723,   -472627.3643   /
000035        I=1
000035        IF (H .GT. 276.395)  I=8
000011        IF (H .GT. +43.712)  I=15
```

```
0000 15          IF (M .GT. 617.209)  I=22
0000 21          IF (M .GT. 968.222)  I=29
0000 25          MX = .001 * M
0000 26          COFMS = A(I) + MX*(A(I+1) + MX*(A(I+2) + MX*(A(I+3) + MX*(A(I+4)
                1 + MX*(A(I+5) + MX* A(I+6))))))
0000 41          IF (FOA .EQ. 0.)  RETURN
0000 44          XB = B(I) + MX*(B(I+1) + MX*(B(I+2) + MX*(B(I+3) + MX*(B(I+4)
                1 + MX*(B(I+5) + MX*B(I+6))))))
0000 57          XC = C(I) + MX*(C(I+1) + MX*(C(I+2) + MX*(C(I+3) + MX*(C(I+4)
                1 + MX*(C(I+5) + MX*C(I+6))))))
0000 71          ER = 14.76015 * FOA
0000 72          COFMS = COFMS + ER *(XB + ER * XC)
0001 00          RETURN
0001 00          END
          *DECK DATA
```

SUBPROGRAM LENGTH
000267

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
ENJ. - 500100

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS

A	-	000111	B	-	000154	C	-	000217	COFHS	-	000110
ER	-	000260	HX	-	000263	I	-	000262	XB	-	000264
XC	-	000265									

START OF CONSTANTS
000101

START OF TEMPORARIES
000107

START OF INDIRECTS
000110

SPACE REQUIRED TO COMPILE
035500

SUBJECT: FUNCTIØN KØUNT

PURPØSE: FUNCTIØN KØUNT counts the number of input points on a ten field seven digit input card.

METHØD: Starting with the right most field a test is made for a blank field. Upon finding a non-blank field that field number is returned as the input count.

USAGE: K = KØUNT (CARD, NFI)

CARD - Array of input points

NFI - Maximum fields defined on card - 10

```
      FUNCTION KOUNT (  CARD,NFI)
      C
      C     KOUNT DETERMINES THE NUMBER OF NON-BLANK INPUT FIELDS ON A DATA
      C     CARD.  THE CARDS ARE PACKED SO THE FIRST BLANK FIELD TERMINATES
      C     THE INPUT.  SEVEN DIGIT FORMAT IS ASSUMED.
      C
0000 05       DIMENSION   CARD(1)
0000 05       NF=NFI
0000 05       K=NF
0000 07       DO 1J I=1,NF
0000 11       IF (CARD(K).NE.0.0) GO TO 20
0000 13       IF (SIGN(1.0,CARD(K)).GT.0.0) GO TO 20
      C     KTH FIELD IS BLANK - CHECK (K-1)TH FIELD
0000 20    1J K=K-1
      C     KTH FIELD NON-BLANK - K DATA FIELDS INPUT
0000 23    2J KOUNT=K
0000 25       RETURN
0000 25       END
```

SUBPROGRAM LENGTH
000034

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
20 - 000023

EXTERNALS AND TAGS
ENJ. - 500100

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
I - 000033 K - 000032 KOUNT - 000030 NF - 000031

START OF CONSTANTS
000026

START OF TEMPORARIES
000027

START OF INDIRECTS
000030

SPACE REQUIRED TO COMPILE
035230

SUBJECT: FUNCTIØN DEMAND

PURPØSE: FUNCTIØN DEMAND computes engine demand, A_O/A_C, as a function of recovery factor.

METHØD: $$\text{DEMAND} = \frac{\text{Area RFW}_C}{A_C} + \frac{\text{Area RFW}_S}{A_C} + \frac{A_{O_{BY}}}{A_C}$$

where $\frac{A_{O_{BY}}}{A_C}$ is from Table 7

USAGE: AØAC = DEMAND(RF)

RF is recovery factor

Area = AREAF (Mach)

W_C = Engine airflow

W_S = Secondary airflow

A_C = Capture area

SUBPRØGRAMS: TABU2

```
      FUNCTION DEMAND(PT2PT8)
      COMMON/AC/AC,ACEAC,ACBYAC,ACBAC,ACIAC
      COMMON/AREAVL/AREA
      COMMON/XMZERO/XMZERO
      COMMON/NC/NCENG,NCSEC
      COMMON/TAB7/TAB7X(10),TAB7Y(10),TAB7Z(10,10),NTX7,NTY7
      COMMON/GAMMA/GAMMA
      CON=AREA          *PT2PT8/AC
      ACEAC=CON*NCENG
      ACBYAC=TAB3Z(ACEAC,XMZERO,TAB7X,TAB7Y,TAB7Z,    NTX7,NTY7,10,10)
      DEMAND=ACEAC+CON*NCSEC+ACBYAC
      RETURN
      END
```

SUBPROGRAM LENGTH
000032

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
TA302 - S00100 END. - S00260

BLOCK NAMES AND LENGTHS
AC - 000005 AREAVL - 000001 XMZERO - 000001 MC - 000002
TA87 - 000172 GAMMA - 000001

VARIABLE ASSIGNMENTS
AC - 010300C01 AREA - 000000C02 A0BYAC - 000002C01 A0EAC - F10001C01
CON - 000031 DEMAND - 000030 NTX7 - 00017CC05 NTY7 - 003171C05
TA37X - 030303C05 TA87Y - 000012C05 TA87Z - 000024C05 MCENG - 000000C04
MCSEC - 000001C04 XMZERO - 000000C03

START OF CONSTANTS
000026

START OF TEMPORARIES
000027

START OF INDIRECTS
000030

SPACE REQUIRED TO COMPILE
035330

```
                FUNCTION AREAF(XMACH)
0000 03         COMMON/GAMMA/GAMMA
0000 03         DATA C/0.013858/
0000 03         AREAF=C*(1.+((GAMMA-1.)*.5)*XMACH**2)**((GAMMA+1.)/(2.*(GAMMA-1.)
               ))/(XMACH*SQRT(GAMMA))
0000 24         RETURN
0000 24         END
```

SUBPROGRAM LENGTH
000036

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
SQRT - 000100 RBAREX.- 000200 END. - 000300

BLOCK NAMES AND LENGTHS
GAMMA - 000001

VARIABLE ASSIGNMENTS
AREAF - 000034 C - 000035 GAMMA - 000000C01

START OF CONSTANTS
000025

START OF TEMPORARIES
000036

START OF INDIRECTS
000034

SPACE REQUIRED TO COMPILE
000200

```
                FUNCTION AEXMST(AEo,GAMMAP,P7QO)
0003J6          GM1=GAMMAP-1.8
0003J7          GP1=GAMMAP+1.8
0003J8          BVP7=1.J/P7QO
0003J1          C1=SQRT((2.0/GM1)*(.5*GP1)**(GP1/GM1))
0003J4          C2=SQRT(1.0-BVP7**(GM1/GAMMAP))
0003J1          AEXMST=AEo/(C1*C2*BVP7**(1.0/GAMMAP))
0003J1          RETURN
0003J2          END
```

SUBPROGRAM LENGTH
000074

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS

EXTERNALS AND TAGS
SQRT - S00100 RWAREX.- S00200 END. - S00300

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
AEXMST - 000060 BP27 - 000071 C1 - 000072 C2 - 000073
GM1 - 000067 GP1 - 000070

START OF CONSTANTS
000053

START OF TEMPORARIES
000056

START OF INDIRECTS
000066

SPACE REQUIRED TO COMPILE
003300

SECTION IV

CROSS-LISTING FOR PROGRAM TEM-333

LABELED COMMON CROSS LISTING FOR PROGRAM TE4333

TE4333	17						
ENGNO	3	MACHN8	122	ONREF	21	INS	3
GAM1A	1	G	1	R	1	TAPENO	2
IBAD	1	IDATA	1	OUTS	45	TITLE	8
PCODE	1	DATE	2	CARD	8	KTRAN	1
NEWM	1						
FIXJIM	0						
ATMOS	0						
PERF	0						
COMPUTE	8						
INS	3	G	1	OUTS	45	MACHN8	122
ONREF	21	NOZARR	41	OUTINL	10	ENGNO	3
OUTPUT	7						
RESULT	*96	PCODE	1	DATE	2	TITLE	8
NEWM	1	IWARN	1	INS	3		
WARNING	3						
IWARN	1	OUTS	45	INS	3		
STORE	3						
INS	3	OUTS	45	RESULT	496		
AREA	0						
CHKRP	0						
OTHRST	1						
ERMES	5						
HOFT	0						
TOFH	0						
PROFH	0						
HOFPR	0						
COFH	0						
COFHS	0						
DATA	0						
READIN	3						
TAPENO	2	CARD	8	IPTAB	1		
TABLE1	0						
TABLE2	0						

TABLES	0						
TABLE22	0						
KOUNT	0						
TABIN	17						
TAB1	21	TAB2A1	221	ENRICH	820	XMMIN	1
TAB2B	21	TAB2C	21	TAB2D	21	TAB2E	21
TAB3	122	TAB4	122	TAB5	122	TAB6A	122
TAB7	122	TAB8B	21	AC	5	IDESGN	3
XMACHS	1						
INCDRAG	17						
OUTINC	10	XMACHS	1	XMMIN	1	AREAVL	1
PT2PTC	1	TAB1	21	TAB2B	21	TAB3	122
TAB4	122	TAB5	122	AC	5	WC	2
XMACH	1	GAMMA	1	PT	1	XMZERO	1
ADAC	1						
SIZING	5						
IDESGN	3	TAB1	21	TAB2B	21	TAB2C	21
AC	5						
AREAF	1						
GAMMA	1						
AIRBYP	15						
PT2PTC	1	AREAVL	1	WC	2	GAMMA	1
XMZERO	1	TAB2A1	221	ENRICH	820	AC	5
TAB6A	122	TAB7	122	TAB2D	21	TAB2E	21
XMACH	1	PT	1	ADAC	1		
AIRSPL	14						
PT2PTC	1	AREAVL	1	XMACH	1	PT	1
XMZERO	1	AC	5	WC	2	GAMMA	1
TAB6B	21	TAB2B	21	TAB2C	21	TAB2E	21
TAB2D	21	ADAC	1				
DEMAND	0						
AC	5	AREAVL	1	XMZERO	1	WC	2
TAB7	122	GAMMA	1				
DRG	2						
A	4	DRGTB	440				
DRAGAB	4						
ABINP	41	ABDRAG	3	A	4	AMAX	1
DUTTS	4						
AMAX	1	ABINP	41	ABDRAG	3	ABTAB1	122
BEAMST	0						
DRAGER	3						
ABTAB4	21	ABINP	41	ABDRAG	3		

[illegible]	5						
DSPACE	1	A	4	AMAX	1	ABINP	41
ABDRAG	3						
[illegible]	6						
AMAX	1	DSPACE	1	ABINP	41	ABDRAG	3
ABTAB3	21	ABTAB2	122				
[illegible]	6						
ABINP	41	AMAX	1	ABDRAG	3	DSPACE	1
ABTAB2	122	ABTAB3	21				
JINTER	4						
ABDRAG	3	ABTAB5	122	ABINP	41	DSPACE	1
OBJATR	2						
ABINP	41	ABDRAG	3				
ABINPT	10						
NOZARR	40	ABTAB1	122	ABTAB2	122	ABTAB3	21
ABTAB4	21	ABTAB5	122	ABTAB6	1033	P8PAL	1
AREA1C	2	XMACH9	20				
CABTAB	6						
XMACH9	20	AREA1C	2	AMAX	1	ABINP	41
P8PAL	1	ABTAB6	1033				
SUBBT	3						
AREA1C	2	A	4	ORGTB	446		
SUPBT	3						
A	4	AREA1C	2	ORGTB	446		

PROGRAM TEM333

	COMMON				REFERENCED SUBPROGRAMS				
1	A	LENGTH	4	5 REFERENCES	DRG	DRAGAB	COCONV	SUBBT	SUPBT
2	ABDRAG	LENGTH	3	8 REFERENCES	DRAGAB PLUGNM	DBTTB DINTFR	DBASER DBOATR	COCONV	PLUGMX
3	ABINP	LENGTH	41	9 REFERENCES	DRAGAB PLUGNM	DBTTB DINTFR	DBASER DBOATR	COCONV CABTAB	PLUGMX
4	ABTAB1	LENGTH	122	2 REFERENCES	DBTTB	ABINPT			
5	ABTAB2	LENGTH	122	3 REFERENCES	PLUGMX	PLUGNM	ABINPT		
6	ABTAB3	LENGTH	21	3 REFERENCES	PLUGMX	PLUGNM	ABINPT		
7	ABTAB4	LENGTH	21	2 REFERENCES	DBASER	ABINPT			
8	ABTAB5	LENGTH	122	2 REFERENCES	DINTFR	ABINPT			
9	ABTABB	LENGTH	1033	2 REFERENCES	ABINPT	CABTAB			
10	AC	LENGTH	5	6 REFERENCES	TABIN DEMAND	INLDRAG	SIZINL	AIRBYP	AIRSPL
11	AMAX	LENGTH	1	6 REFERENCES	DRAGAB CABTAB	DBTTB	COCONV	PLUGMX	PLUGNM
12	AREAWL	LENGTH	1	4 REFERENCES	INLDRAG	AIRBYP	AIRSPL	DEMAND	
13	AREA1J	LENGTH	2	4 REFERENCES	ABINPT	CABTAB	SUBBT	SUPBT	
14	AJAC	LENGTH	1	3 REFERENCES	INLDRAG	AIRBYP	AIRSPL		
15	CARD	LENGTH	8	2 REFERENCES	TEM333	PLACIN			
16	DATE	LENGTH	2	2 REFERENCES	TEM333	OUTGO			
17	DAREA	LENGTH	21	2 REFERENCES	TEM333	COMPUTE			

PROGRAM TEM333

COMMON

19	DRGTB	LENGTH 446	5 REFERENCES	
19	DSPACE	LENGTH 1	4 REFERENCES	
20	ENGNO	LENGTH 3	2 REFERENCES	
21	ENRICH	LENGTH 625	2 REFERENCES	
22	ERMES	LENGTH 5	1 REFERENCES	
23	G	LENGTH 1	2 REFERENCES	
24	GAMMA	LENGTH 1	6 REFERENCES	
25	IEAJ	LENGTH 1	1 REFERENCES	
26	IDATA	LENGTH 1	1 REFERENCES	
27	IDESGN	LENGTH 3	2 REFERENCES	
28	INS	LENGTH 3	5 REFERENCES	
29	IPTAB	LENGTH 1	1 REFERENCES	
30	IWARN	LENGTH 1	2 REFERENCES	
31	KTRAN	LENGTH 1	1 REFERENCES	
32	MACHMS	LENGTH 22	2 REFERENCES	
33	NEHM	LENGTH 1	2 REFERENCES	
34	NOZARR	LENGTH 60	2 REFERENCES	

REFERENCED SUBPROGRAMS

DRG	SUBBT	SUPBT		
CDCONV	PLUGMX	PLUGNM	DINTFR	
TEM333	COMPUTE			
TABIN	AIRBYP			
GTHRST				
TEM333	COMPUTE			
TEM333 DEMAND	INLORAG	AREAF	AIRBYP	AIRSPL
TEM333				
TEM333				
TABIN	SIZINL			
TEM333	COMPUTE	OUTGO	WARNING	STORE
PLACIN				
OUTGO	WARNING			
TEM333				
TEM333	COMPUTE			
TEM333	OUTGO.			
COMPUTE	ABINPT			

PROGRAM TEM333

COMMON

36	OUTIN_	LENGTH	10	2 REFERENCES
39	OUTS	LENGTH	49	4 REFERENCES
37	PCODE	LENGTH	1	2 REFERENCES
38	PT	LENGTH	1	3 REFERENCES
39	PT2PT8	LENGTH	1	3 REFERENCES
40	P8PA_	LENGTH	1	2 REFERENCES
41	R	LENGTH	1	1 REFERENCES
42	RESULT	LENGTH	436	2 REFERENCES
43	TAB1	LENGTH	21	3 REFERENCES
44	TAB241	LENGTH	221	2 REFERENCES
45	TAB2B	LENGTH	21	4 REFERENCES
46	TAB2C	LENGTH	21	3 REFERENCES
47	TAB2D	LENGTH	21	3 REFERENCES
48	TAB2E	LENGTH	21	3 REFERENCES
49	TAB3	LENGTH	122	2 REFERENCES
50	TAB4	LENGTH	122	2 REFERENCES
51	TAB5	LENGTH	122	2 REFERENCES

REFERENCED SUBPROGRAMS

COMPUTE	INLDRAG		
TEM333	COMPUTE	WARNING	STORE
TEM333	OUTGO		
INLDRAG	AIRBYP	AIRSPL	
INLDRAG	AIRBYP	AIRSPL	
ABINPT	CABTAB		
TEM333			
OUTGO	STORE		
TABIN	INLDRAG	SIZINL	
TABIN	AIRBYP		
TABIN	INLDRAG	SIZINL	AIRSPL
TABIN	SIZINL	AIRSPL	
TABIN	AIRBYP	AIRSPL	
TABIN	AIRBYP	AIRSPL	
TABIN	INLDRAG		
TABIN	INLDRAG		
TABIN	INLDRAG		

PROGRAM TEM333

	COMMON				REFERENCED SUBPROGRAMS			
52	TAB6A	LENGTH	122	2 REFERENCES	TABIN	AIR3VP		
53	TAB6B	LENGTH	21	2 REFERENCES	TABIN	AIRSPL		
54	TAB7	LENGTH	122	3 REFERENCES	TABIN	AIR8VP	DEMAND	
55	TAPEND	LENGTH	2	2 REFERENCES	TEM333	PLACIN		
56	TITLE	LENGTH	8	2 REFERENCES	TEM333	OUTGO		
57	WG	LENGTH	2	4 REFERENCES	INLDRAG	AIR8VP	AIRSPL	DEMAND
58	XMACH	LENGTH	1	3 REFERENCES	INLDRAG	AIR3VP	AIRSPL	
59	XMACHS	LENGTH	1	2 REFERENCES	TABIN	INLDRAG		
60	XPACHB	LENGTH	28	2 REFERENCES	ABINPT	CABTAB		
61	XMMIN	LENGTH	1	2 REFERENCES	TABIN	INLDRAG		
62	XMZERO	LENGTH	1	4 REFERENCES	INLDRAG	AIR3VP	AIRSPL	DEMAND

SECTION V

INLET MAP PROGRAM

```
S$$PALV.  0000000000000000000000000000000000000000000000000000000000000000000000000000000000000
S$$DALV.  0000000000000000000000000000000000000000000000000000000000000000000000000000000000000
```

```
RUN   VERSION JUL' 71          11.19.18. 72/06/23.

                  PROGRAM INLTMAP(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
000003            COMMON/TAPENO/IN,IOUT
000003            DATA IN,IOUT /5,6/
000003            COMMON/AREAVL/AREA
000003            COMMON/XMACHS/XMACHS
000003            COMMON/XMZERO/XMZERO
000003            COMMON/XMMIN/XMMIN
000003            DIMENSION OUT8(10),OUT9(10),OUT10(10,40)
000003            COMMON/OUTINL/OUTINL(3),CD,OUTIN1(4)
000003            COMMON/AC/AC,AZZ(4)
000003            COMMON/TAB1/TAB1X(10),TAB1Y(10),NT1
000003            COMMON/TAB2A /TAB2AX(41),TAB2AY(41),N2A
000003            COMMON/TAB2B/TAB2BX(10),TAB2BY(10),NT2B
000003            COMMON/TAB2C/TAB2CX(10),TAB2CY(10),NT2C
000003            COMMON/TAB2D/TAB2DX(10),TAB2DY(10),NT2D
000003            COMMON/TAB2E/TAB2EX(10),TAB2EY(10),NT2E
000003            COMMON/AJAC/AJAC
000003            DIMENSION TITLE(5),LABL(2)
000003            DIMENSION OUT1(10),OUT2(10),OUT3(10),OUT4(40),OUT5(10,40),OUT6(10)
                 A,         OUT7(10)
000003            DIMENSION TMACH(30)
000003            COMMON/GAMMA/GAMMA
000003            DATA GAMMA/1.400/
000003            DATA ZERO/10H      0.00 /
000003            DATA PLABLE/10H   PT2/PT0/
000003            DATA CLABLE /10H        CD  /
000003            DATA ASTER/10H       ****/
000003            P=1.0
000005            READ(5,900) TITLE
000012            WRITE(6,800) TITLE
000020            NTMACH=0
000021            WRITE(6,801)
000025            CALL PLACIN(TMACH,NTMACH,3)
000030            READ(5,810) WCL,DELWC,WCU
000042            WRITE(6,802) WCL,DELWC,WCU
000054            CALL TABIN
000055            BYAC=1.0/AC
000057            IF (DELWC) 20,10,20
000060         10 NWC=1
000061            GO TO 30
000062         20 NWC=IFIX((WCU-WCL-.1)/DELWC)+2
000070         30 J=0
000071            NWC=MIN0(NWC,40)
000075            DO 300 I=1,NTMACH
000076            J=J+1
000100            XMACH=TMACH(I)
000101            WC=WCL
000103            DO 200 K=1,NWC
000104            CALL INLDRAG(XMACH,P,WC,0.0,0,RF)
000110            IF (I.EQ.1) OUT4(K)=WC*BYAC
000115            OUT5(J,K)=RF
000121            OUT10(J,K)=CD
```

```
RUN  VERSION JUL 71          11.19.18. 72/08/29.

000124     200 WC=WC+DELWC
000130         NT2A=-N2A
000132         IF (XMZERO-XMACHS)  205,220,220
000134     205 IF (XMZERO.GE.XMMIN) GO TO 210
000137         WCACOL=ASTER
000140         RFOL=ASTER
000141         CDOL=ASTER
000142         WCACBZ=ASTER
000143         RFBZ=ASTER
000144         CDBZ=ASTER
000145         GO TO 230
000146     210 AJACOL=TBLU1(XMZERO,TAB2EX,TAB2EY,1,NT2E)
000152         RFOL=TBLU1(AJACOL,TAB2AX,TAB2AY,1,NT2A)
000156         WCACOL=AJACOL/(AREA*RFOL)
000160         WC=WCACOL*AC
000162         CALL INLDRAG(XMACH,P,WC     ,0.0,DRAG,RFOL)
000166         CDOL=CD
000170         ENCODE(10,901,RFOL) RFOL
000177         ENCODE(10,902,WCACOL) WCACOL
000207         ENCODE(10,901,CDOL) CDOL
000217         AJACBZ=TBLU1(XMZERO,TAB2BX,TAB2BY,1,NT2B)
000224         IF (AJACBZ.LE.0.0) GO TO 215
000225         RFBZ=TBLU1(AJACBZ,TAB2AX,TAB2AY,1,NT2A)
000232         WCACBZ=AJACBZ/(AREA*RFBZ)
000234         II=0
000235     590 WC=WCACBZ*AC
000237         CALL INLDRAG(XMACH,P,WC     ,0.0,DRAG,RFBZ)
000243         F=AJAC-0.1CBZ
000245         IF (ABS(F).LT.0.00005) GO TO 650
000250         IF (II.GT.15) GO TO 640
000254         IF (II.NE.0) GO TO 610
000254         XX=0.5*WCACBZ
000256         GO TO 620
000257     610 IF (F.EQ.FSAVE) GO TO 640
000261         XX=WCACBZ-(WCACBZ-SAVEW)*F/(F-FSAVE)
000267         IF (XX.LT.0.5) XX=0.5
000272     620 II=II+1
000274         SAVEW=WCACBZ
000275         FSAVE=F
000277         WCACBZ=XX
000300         GO TO 590
000300     640 WCACBZ=-0.0
000302         RFBZ=-0.0
000303         CDBZ=-0.0
000305     650 CONTINUE
000305         CDBZ=CD
000307         ENCODE(10,901,RFBZ) RFBZ
000316         ENCODE(10,902,WCACBZ) WCACBZ
000326         ENCODE(10,901,CDBZ) CDBZ
000336         GO TO 230
000337     215 WCACBZ=ZERO
000341         RFBZ=ASTER
000342         CDBZ=ASTER
```

Moore Business Forms, Inc.

```
RUN  VERSION JUL 71          11.19.18. 72/38/23.

000343          GO TO 230
000343    220 ACACDL=TABLU1(AMZERO,TAB2CX,TAB2CY,1,NT2C)
000350          RFDL= TBLU1(AMZERO,TAB2DX,TAB2DY,1,NT2D)
000354          WCACDL=(1.32*ACACDL)/(AREA*RFDL)
000357          WC=WCACDL*AC
000361          CALL INLDRAG(XMACH,P,WC     ,3.3,DRAG,RFDL)
000365          CDDL=CD
000367          ENCODE(10,901,RFDL) RFDL
000376          ENCODE(10,902,WCACDL) WCACDL
000406          ENCODE(10,901,CDDL) CDDL
000416          RFDZ=ASTER
000420          WCACDZ=ASTER
000421          CDDZ=ASTER
000422    230 OUT1(J)=XMACH
000424          OUT2(J)=WCACDL
000426          OUT3(J)=RFDL
000427          OUT6(J)=WCACDZ
000431          OUT7(J)=RFDZ
000432          OUT8(J)=CDDL
000434          OUT9(J)=CDDZ
000435          IF((J.LT.10).AND.(I.LT.NTMACH)) GO TO 330
                C     OUTPUT RECOVERY MAP
000445          LABL(1)=10HINLET RECO
000446          LABL(2)=10HVERY MAP
000450          WRITE(6,903) LABL,TITLE,XMACHS,AC
000463          WRITE(6,904) (OUT1(L),L=1,J)
000476          WRITE(6,905) (OUT2(L),L=1,J)
000511          WRITE(6,906) (OUT3(L),L=1,J)
000524          WRITE(6,907) (OUT6(L),L=1,J)
000537          WRITE(6,908) (OUT7(L),L=1,J)
000552          WRITE(6,909) (PLABLE,L=1,J)
000564          DO 240 K=1,NWC
000566          WRITE(6,910) OUT4(K),(OUT5(L,K),L=1,J)
000604    240 CONTINUE
                C     OUTPUT DRAG MAP
000617          LABL(1)=10HINLET DRAG
000610          LABL(2)=10H MAP
000612          WRITE(6,903) LABL,TITLE,XMACHS,AC
000625          WRITE(6,904) (OUT1(L),L=1,J)
000640          WRITE(6,905) (OUT2(L),L=1,J)
000653          WRITE(6,911) (OUT3(L),L=1,J)
000606          WRITE(6,907) (OUT6(L),L=1,J)
000731          WRITE(6,912) (OUT9(L),L=1,J)
000714          WRITE(6,909) (DLABLE,L=1,J)
000726          DO 250 K=1,NWC
000730          WRITE(6,910) OUT4(K),(OUT10(L,K),L=1,J)
000746    250 CONTINUE
000751          J=0
000752    300 CONTINUE
000755          STOP
000757    600 FORMAT(1H1,20X,9A10)
000737    901 FORMAT(*)MACH NUMBER ARRAY*)
000737    902 FORMAT(*)CORRECTED AIRFLOW POINTS* 10X 7HINITIAL,12X 5HDELTA, 12X
```

```
RUN  VERSION JUL 71          11.19.16. 72/08/23.

           A3MFINAL /25X,3F17.1 )
000737     810 FORMAT(10F7.0)
000737     900 FORMAT(5A10)
000737     901 FORMAT(F10.4)
000737     902 FORMAT(F10.2)
000737     903 FORMAT(1H1,44X,6A10,5X,10HSTART MACH,F6.3,3X,12HCAPTURE AREA,F7.3)
000737     904 FORMAT(3H0 4ACH NO,12X,10F10.3)
000737     905 FORMAT(17H0DISTORTION LIMIT,/3X,10H(WDC/AC)DL,7X,10A10)
000737     906 FORMAT(3X,11H(PT2/PTO)DL,6X,10A10)
000737     907 FORMAT(11H BUZZ LIMIT /3X,10H(WDC/AC)BL,7X,10A10)
000737     908 FORMAT(3X,11H(PT2/PTO)BL,6X,10A10)
000737     909 FORMAT(1H0,5X,6HWDC/AC,6X,10A10)
000737     910 FORMAT(1X,F11.2,6X,10F10.4)
000737     911 FORMAT(5X,6H(CD)DL,9X,10A10)
000737     912 FORMAT(5X,6H(CD)DL,9X,10A10)
000757         END
```

Adams Business Forms, Inc.

(SAMPLE OUTPUT)

TEST RUN OF INLET MAP PROGRAM

MACH NUMBER ARRAY
.50000 .75000 1.00000 1.25000 1.50000 1.75000 2.00000 .25000 .50000 -0.00000 1

CORRECTED AIRFLOW POINTS INITIAL 60.0 DELTA 10.0 FINAL 300.0

INLET 5.0 3.0 -0.0 -0.0 -0.0

TABLE NUMBER 1

0.00000	1.00000	2.00000	3.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-01 TCAP
0.00000	1.00000	2.00000	3.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0

TABLE NUMBER 2A1

.60000	.80000	.90000	1.20000	1.60000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000-02A1 REV
.73000	.79000	.84000	.95000	.87500	.98000	.91000	-0.00000	-0.00000	-0.00000-0.6
.93000	.98000	.97700	.97000	.96500	.98300	.94000	-0.00000	-0.00000	-0.00000-0
.80000	.85600	.70000	.75000	.77500	.78000	.79500	-0.00000	-0.00000	-0.00000-0.8
.98000	.98000	.97500	.97000	.96500	.98000	.92500	-0.00000	-0.00000	-0.00000-0
.60000	.85000	.70000	.73000	.75000	.78000	.77300	-0.00000	-0.00000	-0.00000-0.9
.98200	.97800	.97400	.97000	.96500	.98700	.92500	-0.00000	-0.00000	-0.00000-0
.87500	.76600	.72500	.75000	.77000	.78000	.79000	-0.00000	-0.00000	-0.00000-01.2
.97200	.97000	.96400	.96500	.96000	.98000	.92500	-0.00000	-0.00000	-0.00000-0
.72000	.77500	.82500	.85000	.86000	.87000	.85000	-0.00000	-0.00000	-0.00000-01.6
.92700	.93400	.93100	.92500	.92000	.91400	.87500	-0.00000	-0.00000	-0.00000-0
.85000	.76000	.75000	.80000	.85000	.90000	.85000	-0.00000	-0.00000	-0.00000-02.0
.79200	.79200	.79200	.79200	.79200	.78000	.77000	-0.00000	-0.00000	-0.00000-0

TABLE NUMBER 2B

0.00000	.20000	.40000	.60000	.80000	1.00000	1.40000	1.60000	1.80000	2.00000-02B REV
.80000	.86000	.93400	.96000	.96500	.98200	.95500	.93300	.84000	.79200-0

TABLE NUMBER 2C

.40000	.60000	.80000	1.00000	1.20000	1.40000	1.60000	1.80000	2.00000	-0.00000-02C REV
1.10000	.96000	.77700	.74200	.75200	.79000	.82000	.82000	.81300	-0.00000-0

TABLE NUMBER 2D

0.00000	1.40000	1.60000	1.80000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-02D TCAP
0.00000	0.00000	.86000	.74500	.79000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0

TABLE NUMBER 2E

.40000	.50000	.80000	1.00000	1.20000	1.40000	1.60000	1.80000	2.00000	-0.00000-02E REV
1.25000	.91000	.79500	.76300	.76300	.87200	.87000	.91000	.94000	-0.00000-0

TABLE NUMBER 3

.60000	.80000	.90000	1.20000	1.60000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000-03
.38000	.38000	.60000	.72500	.82000	.86000	.87500	.95000	1.00000	-0.00000-0
.10000	.02500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00000-0
.22000	.19000	.14000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00000-0.8
.33500	.16700	.10800	.03500	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00000-0.9
.49000	.36000	.21700	.10000	.01500	0.00000	0.00000	0.00000	0.00000	-0.00000-01.2
.63500	.41600	.30500	.16500	.06300	.02000	0.00000	0.00000	0.00000	-0.00000-01.6
.91000	.63000	.49000	.31300	.16300	.10500	.10700	0.00000	0.00000	-0.00000-02.0

TABLE NUMBER 4

.90000	1.20000	1.60000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-04 TCAP
0.00000	.01500	.02000	.03000	.04000	.05000	-0.00000	-0.00000	-0.00000	-0.00000-0
0.00000	.01730	.02300	.02650	.01500	.01100	-0.00000	-0.00000	-0.00000	-0.00000-0.8
0.00000	.01600	.02400	.02000	.01050	.00100	-0.00000	-0.00000	-0.00000	-0.00000-01.2
0.00000	.02000	.02200	.01900	.01500	.01050	-0.00000	-0.00000	-0.00000	-0.00000-01.6
0.00000	.01500	.02300	.02350	.02200	.01900	-0.00000	-0.00000	-0.00000	-0.00000-02.0

TABLE NUMBER 5

0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0 5 TCAP

0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0
0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0

TABLE NUMBER 6A

.80000	1.20000	1.60000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-06A TCAP
.65000	.90000	.82500	.85000	.87500	.90000	.92500	.95000	-0.00000	-0.00000-0
.03200	.01900	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00000	-0.00000-01.2
.03750	.02400	.01900	.01900	.01900	.01900	.01900	.01900	-0.00000	-0.00000-01.6
.04100	.03850	.03720	.03300	.01200	.01200	.01200	.01200	-0.00000	-0.00000-02.0
.05000	.04600	.04790	.04700	.04520	.04500	.04500	.01100	-0.00000	-0.00000-02.8

TABLE NUMBER 6B

0.00000	.68000	.80000	1.20000	2.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-06B TCAP
0.00000	0.00000	.00900	.02600	.04500	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0

TABLE NUMBER 7

0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0 7 TCAP
0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0
0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000-0

INLET RECOVERY MAP — TEST RUN OF INLET MAP PROGRAM — START MACH 3.000 CAPTURE AREA 5.910

MACH NO	.500	.750	1.000	1.250	1.500	1.750	2.000	.250	.500
DISTORTION LIMIT									
(WCC/AC)DL	****	41.35	39.31	39.32	38.44	37.82	35.58	****	****
(PT2/PT0)DL	****	.9265	.9591	.9491	.9245	.8481	.7736	****	****
BUZZ LIMIT									
(WCC/AC)BL	****	0.00	0.00	0.00	15.30	29.37	29.21	****	****
(PT2/PT0)BL	****	****	****	****	.9014	.8781	.7920	****	****
WCC/AC	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0	PT2/PT0
10.15	.9470	1.0073	1.0123	.9872	.8923	.8469	.7920	.8935	.9470
11.84	.9470	1.0051	1.0093	.9857	.8934	.8495	.7920	.8935	.9470
13.54	.9470	1.0030	1.0066	.9841	.8975	.8522	.7920	.8935	.9470
15.23	.9470	1.0038	1.0039	.9826	.9011	.8549	.7920	.8935	.9470
16.92	.9470	.9987	1.0012	.9810	.9047	.8576	.7920	.8935	.9470
18.61	.9470	.9966	.9986	.9795	.9084	.8603	.7920	.8935	.9470
20.31	.9470	.9944	.9959	.9780	.9121	.8631	.7920	.8935	.9470
22.00	.9470	.9923	.9933	.9764	.9158	.8659	.7920	.8935	.9470
23.69	.9470	.9902	.9907	.9749	.9196	.8686	.7920	.8935	.9470
25.39	.9470	.9881	.9881	.9734	.9235	.8714	.7920	.8935	.9470
27.07	.9470	.9861	.9855	.9719	.9272	.8743	.7920	.8935	.9470
28.77	.9470	.9840	.9829	.9704	.9310	.8771	.7920	.8935	.9470
30.46	.9470	.9819	.9803	.9689	.9349	.8799	.7920	.8935	.9470
32.15	.9470	.9798	.9778	.9674	.9388	.8799	.7905	.8935	.9470
33.84	.9470	.9768	.9752	.9659	.9427	.8786	.7853	.8935	.9470
35.53	.9470	.9734	.9726	.9642	.9403	.8726	.7739	.8935	.9470
37.23	.9470	.9694	.9691	.9609	.9343	.8571	.7472	.8935	.9470
38.92	.9470	.9621	.9623	.9528	.9164	.8298	.7147	.8935	.9470
40.61	.9470	.9391	.9432	.9279	.8873	.7953	.6849	.8935	.9470
42.30	.9470	.9060	.9095	.8941	.8515	.7634	.6575	.8935	.9470
44.00	.9470	.8738	.8745	.8597	.8184	.7341	.6322	.8935	.9470
45.69	.9470	.8385	.8421	.8278	.7885	.7069	.6088	.8935	.9470
47.38	.9470	.8036	.8120	.7983	.7603	.6816	.5871	.8935	.9470
49.07	.9470	.7687	.7843	.7707	.7341	.6581	.5663	.8935	.9470
50.76	.9470	.7547	.7579	.7451	.7095	.6362	.5479	.8935	.9470

INLET DRAG MAP TEST RUN OF INLET MAP PROGRAM START MACH 3.000 CAPTURE AREA 5.910

MACH NO	.500	.750	1.000	1.250	1.500	1.750	2.000	.250	.500
DISTORTION LIMIT									
(MCC/AC)DL	****	41.35	39.31	39.32	38.04	37.82	35.58	****	****
(CD)DL	****	-.0023	.0458	.0449	.0142	.0353	.0231	****	****
BUZZ LIMIT									
(MCC/AC)BL	****	0.00	0.00	0.00	15.38	29.37	29.21	****	****
(CD)BL	****	****	****	****	.5272	.1878	.1773	****	****

MCC/AC	CD	CD	CD	CD	CD	CD	CD	CD	CD
10.15	0.0000	.1963	.3754	.5246	.6432	.7648	.8896	0.0000	0.0000
11.84	0.0000	.1806	.3529	.4958	.6059	.7157	.8257	0.0000	0.0000
13.54	0.0000	.1648	.3325	.4671	.5694	.6663	.7624	0.0000	0.0000
15.23	0.0000	.1489	.3123	.4385	.5306	.6167	.6991	0.0000	0.0000
16.92	0.0000	.1331	.2921	.4099	.4925	.5667	.6358	0.0000	0.0000
18.61	0.0000	.1173	.2721	.3815	.4541	.5164	.5725	0.0000	0.0000
20.31	0.0000	.1016	.2521	.3531	.4153	.4657	.5092	0.0000	0.0000
22.00	0.0000	.0869	.2322	.3248	.3762	.4147	.4470	0.0000	0.0000
23.69	0.0000	.0731	.2125	.2956	.3358	.3634	.3848	0.0000	0.0000
25.38	0.0000	.0597	.1929	.2685	.2971	.3116	.3221	0.0000	0.0000
27.07	0.0000	.0477	.1733	.2405	.2656	.2595	.2578	0.0000	0.0000
28.77	0.0000	.0458	.1539	.2129	.2158	.2069	.1937	0.0000	0.0000
30.46	0.0000	.0337	.1346	.1853	.1716	.1537	.1311	0.0000	0.0000
32.15	0.0000	.0265	.1156	.1579	.1350	.1036	.0739	0.0000	0.0000
33.84	0.0000	.0219	.0969	.1305	.0911	.0584	.0210	0.0000	0.0000
35.53	0.0000	.0224	.0777	.1020	.0549	.0492	.0232	0.0000	0.0000
37.23	0.0000	.0228	.0623	.0738	.0381	.0378	.0167	0.0000	0.0000
38.92	0.0000	.0196	.0483	.0493	.0314	.0323	.0167	0.0000	0.0000
40.61	0.0000	.0036	.0438	.0387	.0219	.0323	.0167	0.0000	0.0000
42.30	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000
44.00	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000
45.69	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000
47.38	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000
49.07	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000
50.76	0.0000	-.0023	.0379	.0358	.0219	.0323	.0167	0.0000	0.0000

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13 ABSTRACT
This report presents the results of a research program to develop a procedure for use in calculating propulsion system installation losses. These losses include inlet and nozzle internal losses and external drag losses for a wide variety of subsonic and supersonic aircraft configurations up to Mach 4.5. The calculation procedure, which was largely developed from existing engineering procedures and experimental data, is suitable for preliminary studies of advanced aircraft configurations. Engineering descriptions, equations, and flow charts are provided to help in adapting the calculation procedures to digital computer routines. Many of the calculation procedures have already been programmed on the CDC 6600 computer. Program listings and flow charts are provided for the calculation procedures that have been programmed. The work accomplished during the program is contained in four separate volumes. Volume I contains an engineering description of the calculation procedures. Volume II is a programmers manual containing flow charts, listings, and subroutine descriptions. Volume III contains sample calculations and sample input data. Volume IV contains bookkeeping definitions and data correlations.

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KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Afterbody Drag						
Boattail Drag						
Bookkeeping Aero-Propulsion Forces						
Boundary Layer Bleed Drag						
Bypass Drag						
Inlet Performance						
Inlet Shock Losses						
Nozzle/Afterbody Installation Losses						
Nozzle Interference Drag						
Nozzle Thrust Coefficient						
Propulsion Installation Losses						
Spillage Drag						
Subsonic Diffuser Losses						
Supersonic Inlets						
Total Pressure Recovery						